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THE FOUNDRY

Vol. 30. No. 6 CLEVELAND, OHIO, AUGUST, 1907 Whole No. 180

THE TRAINING OF APPRENTICES IN FOUNDRY WORK

A Successful Course of Education Introduced by the Ingersoll-Rand Co., at Phillipsburg, N. J.

F THE many perplexing problems confronting American foundrymen none has proved more difficult of solution than the training of apprentices. The demand for skilled molders in recent years has been constantly greater than the supply, and few, if any, of the trade schools that have undertaken this work have thus far produced mechanics of sufficient ability to command journeymen's wages. The labor market of large and congested centers is sacrificed with the location of plants in small communities for other advantages, such as lower taxes, cheap land and ample room for expansion. To augment the labor supply inexperienced hands are trained and very favorable results have been obtained, not only in foundries, but rolling mills, steel works, machine shops, and other industrial plants.

At Phillipsburg, N. J., is located the large works of the Ingersoll-Rand Co., manufacturer of air compressors and air tools, of which a foundry employing some 900 men is one of the components. With the possible exception of fifteen, all of the molders have been trained in this foundry or in the plant at Easton, located on the opposite side of the Delaware river, in Pennsylvania, where the company operated exclusively until about four years ago.

Plan of Education.

The plan of education, from which such excellent results have been obtained was originally outlined by Philip C. Smith, foundry superintendent, eleven years ago, and with few modifications, is still being pursued.

The foundry, equipped with four cupolas, has an average daily output of 100 tons of the most intricate castings, dry sand work predominating. The cores of practically all of the sections are complicated, yet the losses are considerably below normal. This is the more suprising, in view of the fact that many of the molders are still in their 'teens, while others have yet to experience the joys of casting their first presidential ballot. The core department has been christened "The Kindergarten," as it is here that the embryo molder is first introduced to the mysteries of foundry practice. Fourteen is the minimum age of enrolment and the course covers a period of four years.

Initial Duties.

To acquaint himself with his surroundings, the boy is given only light duties to perform during the first few

weeks of his employment, and his tutor, aside from the chief of the department, is a youth who has had not less than three months' training. The pair work together during a similar period, when the one most advanced progresses to the side of another who has probably worked for nine months, and the three months' apprentice is charged with the duty of leading another through his first steps. This mode of procedure is carefully followed until the end of the first year, when the boy is graduated from the core department and his compensation increased from $1 to $1.25 per day. Instead of placing him immediately on the floor to acquire the rudiments of molding, he is intrusted to the tender mercies of the melter for three or four weeks, to obtain a knowledge of charging, melting, tapping and cupola repairs. As a result of this practice every molder in the plant can melt successfully.

Core Department.

Objections might be raised to the employment of the apprentices in such large numbers in the core department, but the success of the venture is indicative of the wisdom of this practice. The core boxes, largely metal, have been made practically "fool proof" and after a brief experience the most intricate shapes are produced in large numbers daily. The boys are taught the various mixtures and the methods of baking, thus giving them the equipment of those making a specialty of core work. Nor is this apprenticeship system limited to boys alone, as laborers in the plant inclined to take up this trade are permitted to take up the course.

Rudiments of Molding.

With the advent of the apprentice on the molding floor he is made an assistant to another slightly more advanced, and in some cases works with an experienced molder. His lot is not that of an ordinary helper, as he is given every opportunity to advance and as he masters the simpler sections he is given more complicated work. The supply of common labor is liberal and such duties as are only too often associated with the learning of this trade and are styled as "breaking in chores," are left to the laborers to perform. The undivided attention and effort of the apprentice can thus be applied to obtaining a knowledge of his chosen calling and his forward strides are consequently rapid. The mode of advancement in the core room applies in the molding department and with the third year the daily wages are increased to $1.75.

Third Year.

At this period many of the boys have the equipment of the average molder and are permitted to make those sections for which they are best fitted. During the fourth year many of the apprentices are paid the same wages as the skilled mechanics, as the question of stipend is governed alone by their ability. No agreements are signed by the company, nor is one required of the parents of the boys. If, after a reasonable period the apprentice shows no talent for the work, he is dropped and the cause for this action is carefully explained.

Discipline.

Notwithstanding the average ages of the employes the discipline is remarkable. The only penalty is suspension for a week and it is seldom that this must be enforced. Shop rules have never been posted and those that govern are such as are generally understood and are passed from one employe to another. Although 10 hours constitutes a day the men are permitted to leave at 4:30 in the afternoon if their work is done. As in other foundries, the time of pouring off of the floors is changed from day to day, that this privilege may be accorded to all.

Night Work.

Over time is not allowed in any department of the plant and the employes, knowing that their work must be finished in 10 hours, always succeed in ending their labor with the termination of the working day. Nor is the shaking out of the castings nor the cutting of the sand done at night, as ex-

perience has shown that this is an unnecessary expense, as the daily output is the same as when the molders were aided in this way.

Supply Store.

A supply store operated in connection with the foundry is another feature that has proved exceedingly profitable. Each molder obtains his material in the way of nails, chaplets, facing sand, parting compounds, etc., for his day's work from the storekeeper and in this way the supplies required for each job can be accurately checked. To enable the clerk in charge to post his books, the store is closed at an early hour in the afternoon.

Daily Report.

That the operation of the foundry may be checked from day to day, a daily report is made of the cost per ton in wages of the castings produced and careful record is kept of the amount of sand used, distributed among the green sand, dry sand and bench molding floors. In arriving at the cost of productive labor, the following factors are considered: Cost of molding per ton, coremaking, chipping and cleaning. The variations in these expenses serve as a check on the different foremen and enable the superintendent to immediately locate any rapid increase in the productive cost. The following charges under the head of "Expense Labor," are also made: Charging cupola; handling patterns; firing ovens; carpenters; operating cranes; mixing sand; carrying flasks; dry sand labor; unloading material; office force and foundry machine shop. These items give the cost of "Expense Labor" per ton, cost of shop per ton, and the total daily wages.

Foremen's Orders.

Orders are also given each foreman every day of the number of pieces of the various sections that are to be produced. By this method the tonnage can be maintained at a minimum as the anticipated output is indicated before the day's work has been commenced. If the total falls below the requirements the cause is immediately sought. Furthermore, the superintendent indicates the molder that is to be placed on each job and in this way favoritism is overcome and the most efficient is given the work for which he is best fitted.

Brass Foundry.

The labor problem in the brass foundry is handled in a manner similar to that followed in the grey iron department. All of the material must be secured from the storekeeper and if the variations between the weight of the castings and the metal obtained from the store is over 3 per cent an investigation is made. Losses so prevalent in brass shops have thereby been entirely obviated and the fact that there is a check on the material has had a wholesome effect.

Organization of Pattern Shop.

The organization of the pattern shop is novel and since the Smith system has been adopted the output has shown an enormous increase. The original layout was similar to that of all other shops, the tools, such as lathes, planers, etc., being on the patternmaking floor. Each patternmaker laid out his own work and cut the material for the job. When this department was placed under Mr. Smith's supervision he concluded that the work could be facilitated if the laying out and the cutting of material were done by men skilled in these branches. Two men were consequently secured to lay out the work for the entire patternmaking force and others were employed to prepare the material. With the exception of a few saws all of the tools in the patternmaking department were removed and set up in another part of the shop. After the work is laid out and the material cut it is taken to the pattern floor in trucks, and with the blue print as a guide, the patternmaker is only required to fit, nail and glue his material. Not only has there been a big reduction in the time required on each job, but a great saving has also been effected in the amount of material consumed. Practically half of the patternmaking force consists of apprentices,

and many of the journeymen are products of this successful system.

Pattern Storage.

The method of handling and storing patterns is also very simple, no card system being used. The pattern storage is divided into rooms, each one of which is numbered, containing shelves which are likewise indicated consecutively. The storage room and shelf numbers are stamped on each pattern and these symbols are transferred to the office records and the requisitions clearly show where the patterns are to be found. Their return to the storage is thereby simplified and an expensive card system is obviated in this way.

Foundry Machine Shop.

A machine shop for the production of metal patterns, the finishing of iron flasks and such other work as is required from day to day is an adjunct of the foundry and is in charge of its superintendent. Delays encountered in having odd jobs done in the general machine shop are no longer experienced and as the employes have become skilled in this line of work, the cost of the same has been materially reduced.

PERSONAL.

Solomon Ginsburg has been elected president of the New York Car Wheel Co., Buffalo, succeeding Joseph H. Berry, deceased. W. G. Smith has been chosen vice president and J. A. Venable secretary and treasurer of the company.

A. R. Lentz, formerly superintendent of the foundry operated by the Williamson Bros. Co., Philadelphia, has been appointed superintendent of the Heindel Foundry Co., Hanover, Pa. This concern has recently acquired the plant of the American Foundry & Machine Co., at that place and will operate the same in connection with its present plant.

The king of Greece has conferred upon Geo. G. Blackwell, chairman of the firm of Geo. G. Blackwell, Sons & Co., Ltd., Liverpool, England, the gold cross of Officer of the Royal Order of The Saviour, in recognition of his services in connection with the development of the mining industries of Greece.

R. E. Coleman has been appointed assistant general superintendent of the American Brake Shoe & Foundry Co., Mahwah, N. J. He has been superintendent of the company's East Buffalo plant for several years.

Arthur H. Buhl has been elected president of the Buhl Malleable Co., Detroit, to succeed his father, the late Theodore D. Buhl. Mr. Buhl has also been made vice president and general manager of the Buhl Sons Co., of which his brother, Willis E. Buhl, has just been elected president. Leon Smith has been made a member of the board of directors.

Robert Aiken, Toledo, O., has been appointed general superintendent of the Lloyd-Booth department of the United Engineering & Mfg. Co., Youngstown, O.

OBERMAYER BULLETIN.

The May and June number of the *Obermayer Bulletin*, issued by the S. Obermayer Co., Cincinnati, contains the following special articles: "Rat Tailing from a Technical Viewpoint;" "The Right Way to Run a Foundry;" "Progression of Work in the Foundry;" "Chemistry and Experience in the Foundry;" and "How to Slag a Cupola."

GUN METAL.

This alloy is so-called because it was at one time largely used for casting guns. It contains about 90 per cent of copper and 10 per cent of tin, and is one of the strongest of the copper-tin alloys. The term "gun metal" should be restricted to alloys containing about 10 per cent of tin, but is now often used as a synonym for bronze and sometimes for triple alloys containing zinc as well as tin.

PRODUCER GAS MELTING FURNACES.

Question.—Have any form of producer gas fired furnaces been used for brass melting?

Answer.—While producer gas has not yet been adopted as fuel for brass melting, nevertheless its use is being considered by a number of large brass foundries.

SANDLESS CASTINGS*

Casting Brakeshoes in Permanent Molds that Automatically Provide for Expansion

JOHN H. SHAW

CASTING in so-called chills is a method well known at the present time. Outside of the making of rolls and ingot molds, we find the method used for making bedsteads, sash weights, and other simple castings where there is no difficulty from undue expansion and contraction. The troubles arising from an iron mold, and the lack of understanding the regulation of temperatures in casting into chills, have caused many a failure of an otherwise good idea.

The greater part of these objections have been overcome by the construction of a peculiarly arranged mold, as shown in Figs. 1 and 2. The parts of the mold are so arranged that they automatically open out sufficiently to take care of the expansion due to heating without destroying the correctness of the castings made. The further manipulation of the molds in filling them with molten iron depends upon a proper knowledge of the temperature they must be kept at to insure the best all around results.

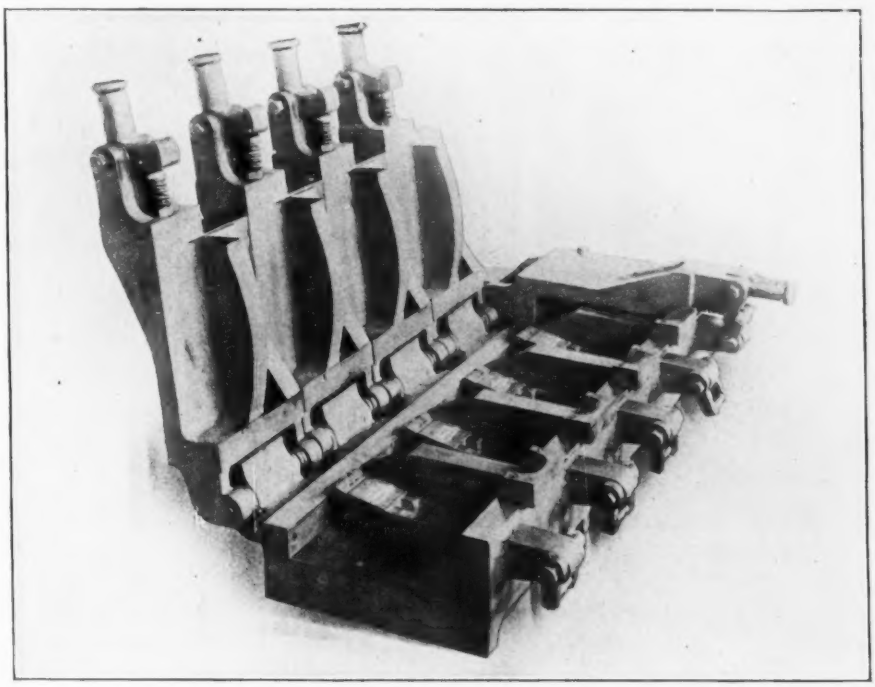


FIG. 1.—M. C. B. A. BRAKESHOE MOLD

Construction of the Mold.

The mold is constructed essentially in two parts: The outer shell which may be locked readily, and the inner dies in close contact with the shell, and securely fastened to it. The design of the mold is such that expansion

*Presented at the Philadelphia convention of the American Foundrymen's Association.

in two directions may readily take place unhindered except for powerful springs. The arrangement of dies and shell allows of a ready replacement of the former when damaged, this depending upon the thickness of the mold and the temperature they are allowed to reach, their composition, of course being such that a high melting point is attained. Further attention is given to the molds in designing them, so that they may be closed and opened very quickly, and thus rapid work accomplished.

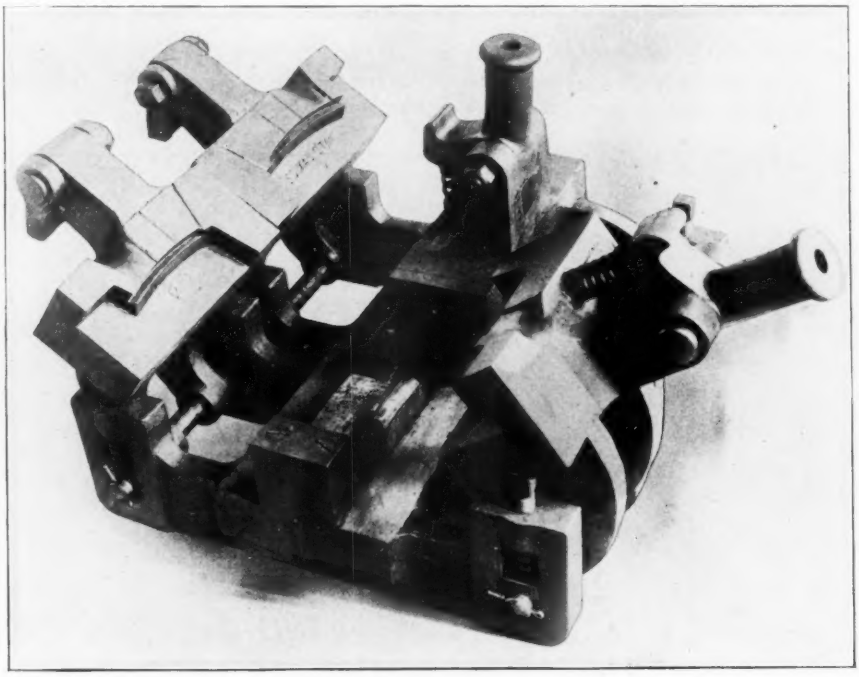


FIG. 2—KEYSTONE BRAKE SHOE MOLD

Operating the Mold.

In operating a sandless mold, it is necessary to coat the metal in contact with the molten iron occasionally with a compound containing graphite and crude oil, or other refractory substance carried in a vehicle which in being driven off by heat will not ruin the surface of the casting.

In operating the mold, after spraying it, the first few castings are rejected, the intention being to heat up the mold, though in continuous work, this may be accomplished in a special heating furnace or oven if desired. All cores are set in the regular way before casting. The metal is poured in rapidly, and the mold opened as quickly as possible provided that the metal is set sufficiently that no bleeding takes place. The elastic condition of the mold however, prevents trouble if this time is not kept properly and the casting allowed to remain in the mold too long, the disadvantage of such a procedure in allowing the mold to heat up too much is naturally evident. The casting is then taken out and piled up so that the whole mass may cool slowly, so that the chilling effect of too rapid cooling may not cause hard spots.

The molds should not be allowed to get too hot, that is beyond 900 degrees Fahr., otherwise they are liable to expand permanently and cause trouble.

Coating the Dies.

It is only necessary to coat the dies every fifth pouring, more or less, the idea being to get a thin layer of the refractory material evenly spread over

the face of the dies, which layer is properly kept up. Between this and a hot mold, and fairly soft iron, no undue chilling effect results in the casting beyond the very desirable closing up of the grain of the metal. In the case in point, the making of brake-shoes, every fifth cast requires a spraying of the mold.

The system can of course be adapted to mechanical elaboration in order to get the lowest shop cost. Thus by performing many of the small operations automatically, by special devices, or arranging the molds to pass the point of pouring, much labor can be saved. The work that can be made by sandless molds is naturally of a standard kind, where large quantities of the same piece are required. Hence its introduction for the brake-shoe, iron bedstead, and other work. Moreover for the car wheel, the usual cold chill, with a suitable adaptation of a center core makes a very easily handled wheel.

Disadvantages.

In presenting a method to the foundry, it is always well to look at both sides of the problem. That is to show its advantages and disadvantages. Here are the latter.

The sandless mold is best adapted only to work of fairly large size, though practically everything can be made in this way if proper care is taken in the niceties of the construction and manipulation.

The heating of the mold consumes some time and uses metal which must be returned to the cupola, though this can be avoided by heating in the oven. Molds are naturally expensive at first, and hence advisable only when a large number of castings are to be made of a kind.

The red hot castings, if small, where machinery is to be done, or special requirements are demanded, must be practically annealed, either in pile, or by an oven. The silicon of the metal also must be a little higher than for sand castings.

Advantages.

The advantages are as follows:

A limited number of molds will make a large number of castings with very little labor, and this is not high class.

The surface of the castings being practically smooth, and accurate in dimensions, the loss of extra metal through excessive rapping of patterns in sand work is avoided, and no expensive cleaning department is required beyond some little grinding of thin fins.

The life of the molds is long, as may be seen in ingot molds for brass, and iron bedsteads.

The foundry plant is very small for a heavy tonnage.

The process is adaptable for continuous melting and operating.

Interchangeability of the dies in the shell makes it easy to keep the molds up to standard, and these dies being of cast iron are inexpensive.

The installation of an expensive power plant is eliminated, the only power required being electricity sufficient to run cupola blower.

CONVENTION FEATURES.

The June number of *The Blast*, issued by the Detroit Foundry Supply Co., Detroit, is replete with sketches of some of the unofficial features of the Philadelphia convention of the American Foundrymen's Association. In addition, it contains a complete report of the annual meeting of the Associated Foundry Foremen, and the "Random Talks on Iron" have been continued with an article entitled "Steel Processes in Different Countries." This number contains 28 pages and is bound in a handsome cover.

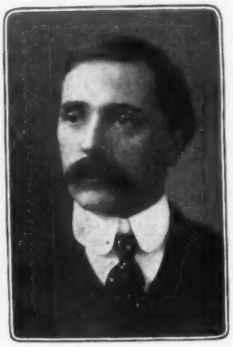
REQUEST FOR CATALOGS.

Prosper Aubie, Engineer, Societe Metallurgique du Perigord, Fumel, Lot et Garonne, France, would like to receive catalogs from manufacturers of foundry equipment of machinery suitable for installation in pipe foundries. The company with which Mr. Aubie is associated operates a plant having a daily capacity of 120 tons and it is probable that the contract for the rebuilding of the same may be awarded American manufacturers.

CASTING UNDER DIFFICULTIES

Pouring a Fifty-Ton Forging Machine Frame with Limited Melting Capacity and Insufficient Crane Power

JABEZ NALL



THE MAKING of a 50-ton casting is not a difficult problem in a foundry having ample cupola capacity with modern charging apparatus and sufficient crane power for the easy handling of the molten metal and the finished casting, but under other conditions it becomes a very different proposition. It is unnecessary to inform the molder that only a few of the many foundries in this country have up to date equipment, especially for this class of work. This article will briefly describe the making of such a casting under difficulties. The credit for the excellent arrangements made to overcome these difficulties, the overseeing and ultimate success should be given to John Vodraski, the foundry superintendent of the Ajax Mfg. Co., Cleveland.

Figs. 1 and 2 show the mold during the progress of setting the cores, the views being taken from opposite corners. Fig. 1 shows the cope in the background, set up on blocks for finishing and drying. Fig. 2 shows the arrangement for anchoring out the part of the mold above the wing of the casting, with the finished anchor in the background. Fig. 3 shows the mold clamped down and center weighted, with runners made as shown in the front and at the right of the illustration. Another runner to the left, the lines of which are but barely visible, is carried out to a point in line with the one to the right, Fig. 3. The reason for this will be seen later. Fig. 4 shows a view of the finished casting.

Thus far the arrangement of the patternmaker, together with the careful work of the molder and coremaker, have eliminated all risk beyond that which will always attach to the foundry business. But now we must consider the difficulties to be encountered before our job is complete. Figs. 1 and 3 indicate the height of the crane runway, 16 feet, and the small amount of headroom provided. Upon this runway are two 3-motor traveling cranes of a maximum lift of 5 and 20 tons respectively. On the same girders of the large crane is an auxiliary hand power crane with a maximum lift of 7 tons, having hoist and rack, the traverse being, of course, with the main crane. This is the ultimate of our crane power.

A single cupola, 6 feet, 6 inches diameter, for which a No. 10 Sturtevant fan directly connected to a 50-horsepower motor gives a good blast, is provided, the whole giving a melting capacity of 12 to 13 tons per hour. The area of the charging floor is very limited and it is not possible to store more than 25 tons of pig iron and a small amount of scrap. The balance of this, as well as the coke required, must be hauled during the progress of the heat. The charging is done by the "strong arm" type of charging machine, in other words, hard labor.

Fig. 3 indicates the position of the large ladles. The mold being set across the foundry floor, runners 18 feet in length are built at each end, that the 15 and 18-ton ladles may be set in line with the 7-ton on the auxiliary crane and that they may be handled without using the traverse of crane. These

FIGS. 1 AND 2—VIEWS OF THE MOLD WHILE SETTING THE CORES
FIG. 3—FINISHED MOLD SHOWING ARRANGEMENT OF RUNNERS

three give a capacity of 40 tons, but we are still 10 tons short, so two 5-ton ladles are arranged for the small traveler.

The length of time required for melting presents a problem of how to keep the iron hot for 4 to 5 hours. This is done by first getting the ladles to a good heat, then using a 6-ton ladle to travel to and from the cupola. The first 10 tons or so are poured into the 18-ton ladle and the next into the 15-ton ladle from the small crane at the runner to the right of Fig. 3, followed by the 18-ton at the other end of same runner. As this is about empty we commence pouring the 7-ton from the hand power crane. In the meantime the large ladle is set down and the crane racked out to take up the 15-ton. While this is being emptied the small crane is back with the last ladle and as much of this as is needed to fill up is poured into the top gate and the

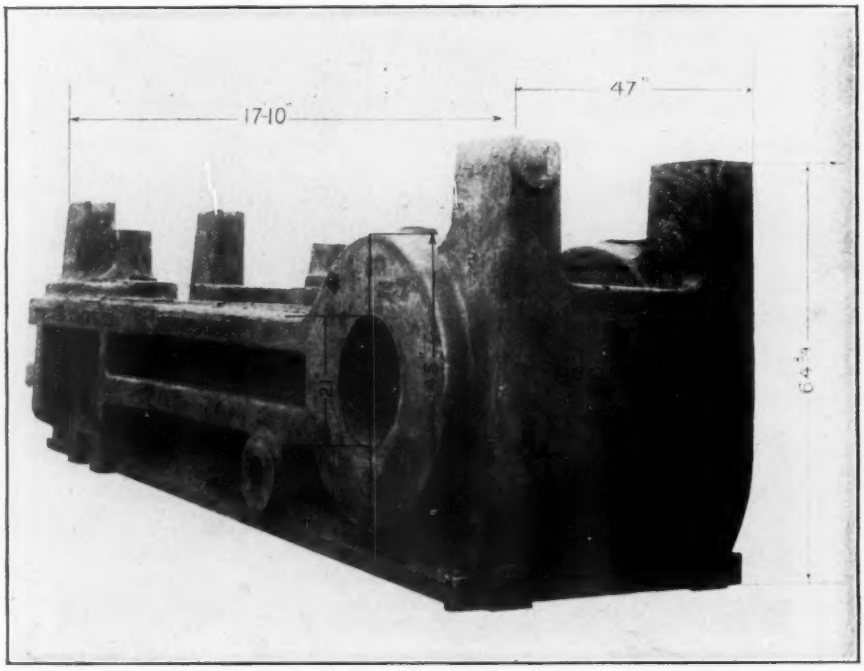


FIG. 4—THE FINISHED CASTING

ton. In the meantime these are kept covered with a charcoal fire and then the next 5 tons of hot iron are poured into the 18-ton ladle which is again covered with charcoal. After this the 15-ton ladle is filled to its capacity, and next the 18-ton ladle. Care must be taken to keep the crust from getting so thick as to prevent pouring. The 7-ton ladle is next filled and placed in a convenient position to be picked up by the hand power crane, and a 5-ton ladle is filled and placed at the side of the mold, while a second one is set under the cupola. As this is still working satisfactorily (which has always been the case so far) we can commence pouring. We first empty the 5-ton ladle from the small crane at the runner to the right of Fig. 3, followed by the 18-ton at the other end of same runner. As this is about empty we commence pouring the 7-ton from the hand power crane. In the meantime the large ladle is set down and the crane racked out to take up the 15-ton. While this is being emptied the small crane is back with the last ladle and as much of this as is needed to fill up is poured into the top gate and the operation, having taken in all perhaps 7 minutes, is completed.

The superintendent gives a sigh of relief and having still some iron in the cupola, he sees to the casting of the other emergency pieces on the heat, keeping enough hot iron for the feeding of the large casting. But you may ask, "What would happen if anything should go wrong with the cupola and maybe half or more of the heat down?" Well, there are a score of other ifs besides this one, and in this case, the best thing to do is to have it arranged that another casting of about half size be ready on the same day. Then you can pour one or the other, at least, and lay one over.

IRON CASTINGS—SOME CAUSES OF FAILURE IN SERVICE*

Method Pursued in Ascertaining Defects in Locomotive Castings and the Remedies by which they were Overcome

ROBERT JOB

EVERY manufacturer and user of iron from time to time meets with casting difficulties owing to defects in the iron, and in order to reduce fractures, discards and unsatisfactory service to the minimum, it is of great importance to know definitely the cause of the defects in order to apply the proper remedy.

In the course of everyday practice for many years, the writer has been interested in making a careful study of these matters as an aid in working out the most economical methods of manufacture and in securing the greatest efficiency in the output, and it may be of interest to give some details which have been observed from time to time.

Purchase of Iron.

In many foundries today, as was the case in one which first came under attention fifteen years ago, the practice is to purchase a number of different grades of iron—not by analysis, merely by brand—and to mix these in the cupola, with the object of obtaining special virtue from the combined properties of the metals. The underlying reason for this plan is simply that one brand runs high in silicon while another contains an excess of manganese, and still another is high in phosphorus making the iron very fluid, and very weak. The inherent defects of this method of mixing are well known to every foundryman, for difficulty is found in keeping up shipments of each of the different brands, and even when they are in stock, it is by no means an easy matter to get a correct mixture in the cupola even under the most favorable conditions. Consequently the foundryman is troubled by irregular quality of castings, and it is difficult to maintain proper control of the output, simply because there is great difference in the composition of the iron from day to day and even in different parts of the heat, when the intention has been to make a uniform grade of castings.

Variations in Composition.

Part of this variation is due to the differences in the composition of different lots of a given brand of iron. For example, we have known of different shipments of one brand which have ranged from 0.8 per cent of phosphorus to 1.5 per cent of phosphorus, while another showed an equal range in its manganese contents, and still another has varied from 2 to 5 per cent in silicon. Under such conditions it is obviously out of the question to expect uniform results in the product, for at one time the iron is strong and tough, while soon afterward it is weak or brittle, or is full of blowholes and porous, and the foreman, who under the best of conditions is none too free from troubles, finds himself in serious difficulty.

In order to secure uniformly good results it is obviously essential at the start to have in the finished casting a composition which will give the properties needed in service, and also adapted to the conditions of casting. Many service failures in the writer's experience have been caused directly by this neglect to obtain a uniform composition suited to the service. We remember particularly instances in which locomotive cylinders and wheel centers failed within a short time, and on investigation it was found that the proportion of phosphorus averaged nearly one per cent, while the silicon

*Presented at the June meeting of the American Society for Testing Materials.

was over two and one half per cent. As a result the iron was so weak that little tenacity under impact could have been expected, although the price paid for this grade was considerably higher than the market rate for quality far better adapted to the service.

In order to put a stop to these conditions under our own practice, a careful study was made to determine both the composition and physical condition and structure which gave the best service under different classes of requirements, and to determine the means necessary to secure this quality in the output.

Causes of Failures.

In many cases of failure we found that the difficulty was due wholly, or in large part, to the presence of blowholes or to porosity or sponginess of the iron, and at times to the presence of considerable proportions of oxide of iron and cinder in the iron. Any of the latter conditions, of course, were direct indications of defective foundry practice and where they existed, defective composition was also often present.

In the daily routine of our foundry, general locomotive castings were made ranging in size from locomotive cylinders and wheel centers to small castings about one-quarter of an inch thick, and most of the castings required machining in some part. In view of this wide variation in size and conditions of service, some doubt was felt whether a single grade of pig iron would meet the requirements. At the outset, however, we drew up specifications for a strong medium iron and upon receipt of each shipment, sampled and tested each carload before acceptance, to be certain that it was of the desired quality. The same practice was also adopted with reference to our coke supply, and the proportion of ash and of sulphur were held down to reasonable amounts. At the same time methods of treatment of the iron in the ladle and in the cupola were introduced to decrease hardness and to remove oxide of iron and blowholes, and to increase the fluidity and density of the iron.

Improvement in the Quality of Castings.

As a result of these changes excellent results were obtained from the very start. The single grade of iron with the careful control of the quality, gave a degree of uniformity which had never before been possible, and by means of systematic treatment the properties of the iron could be varied as far as was desirable for the different purposes.

In the machine shops the change had an immediate effect, for hard castings, "porous iron" and blowholes almost entirely disappeared. Within a few months breakages in service had fallen off to a very marked extent owing to the toughening of the iron, and at the end of the year the scrap coming in was insufficient for the needs of the foundry. In order to keep track of the service, we stamped each wheel center as it was cast, with the date, and after a lapse of three years not a single one had been broken in service.

In the course of our routine work we found comparatively little difficulty in maintaining the desired quality in the shipments of the pig iron and the coke, though we soon learned that the systematic test of each carload of the raw materials was essential to insure proper quality of the product, for at one time a carload of weak iron would be kept from service, and at another time iron which would have produced hard and brittle castings. Still again, coke would not be accepted which proved to be deficient in heating value or was of such quality that hard castings would have resulted.

Cost of Pig Iron Decreased.

By means of the method of purchase under specifications the cost of the pig iron was decreased, and in the foundry the proportion of discards was cut down owing to the fluidity of the iron resulting from the cleansing of the metal from oxides and slag, and to the increased strength and toughness of the product.

From what has been said it will be evident that there is a definite cause for each of the defects which commonly cause difficulty in service or in the foundry, and it will be seen that these may be very largely removed by means of systematic control.

RAPID GROWTH OF THE NORTHWESTERN MALLEABLE IRON CO.

To commemorate its 25th anniversary, the Northwestern Malleable Iron Co., Milwaukee, has issued a handsomely illustrated 20-page brochure, which briefly sketches the career of this concern from its inception to the present day.

The firm was established June 27, 1882, and was known as Elmore, Sivyer & Co., Eltinge Elmore, Frederick W. Sivyer and William A. Draves being the organizers. Operations were commenced with a small cupola, one annealing oven, and a modest building to house the entire shop, while a little cottage served as an office. The working force consisted of 25 men and although the capacity claimed was 600 tons per annum, it was some time before that production was reached. Shortly after the business was organized, Mr. Elmore retired, selling his interest to Helmus M. Wells. The first work which came into the shop was light and plain, but before many months contracts were made with several agricultural implement manufacturers. For producing this class of material, the cupola was found inadequate and in 1883 was supplanted by a small reverberatory furnace. On May 15, 1883, the firm name was changed from Elmore, Sivyer & Co., to the Northwestern Malleable Iron Co.

Articles of incorporation were filed Sept. 8, 1888, Mr. Sivyer becoming president, Mr. Draves vice president, and Mr. Wells secretary and treasurer. In the meantime the output had practically doubled and another furnace was added to provide facilities for the constantly growing demands. Mr. Wells died Jan. 20, 1890, and on July 23, 1894, O. L. Hollister was elected secretary. John M. Potter was elected treasurer in July, 1896, having become affiliated with the concern shortly after the death of Mr. Wells.

After ten years of growth, the annual sales were increased six-fold, and the capacity from 600 tons per year to 5,000. The number of employes was increased to 600. On July 1, 1902, Mr. Hollister resigned to become associated with the West Allis Malleable Iron & Chain Belt Co., of which concern he is now president. Frederick L. Sivyer, son of Frederick W. Sivyer, succeeded to the office of secretary, and at the same time was elected superintendent, succeeding Mr. Draves, who continued as vice president until his death in March, 1906. On April 16 of this year, D. Ralph Day was elected secretary and the eldest son of the company's first secretary, Helmus B. Wells, was elected second vice president. With a view to keeping the plant abreast of the times, many additions have been made and old shops rebuilt.

At the end of 25 years, the company's capacity has increased from 600 to 30,000 tons and the small cupola, with which operations were begun, has been replaced by eleven reverberatory furnaces which are housed in six separate buildings. In addition to the furnaces, a 10-ton cupola is used for casting annealing pots, and 15 annealing ovens are required for the castings produced daily. In the last quarter of a century, the historian states that there have been few radical changes in the malleable foundry practice. The style of the furnace, the method of melting and the process of annealing have remained practically the same in that period. The most noteworthy innovation was the introduction of the chemist and this concern was among the first of the manufacturers of malleable castings to build and equip a laboratory.

THE PATTERN SHOP

ARRANGEMENT OF A PATTERN SHOP IN A CONFINED SPACE

OSCAR E. PERRIGO

THE requirements of this case were as follows: The available space was in the corner of a large machine shop. The width of this space could not be over 24 feet, although the length might be whatever was necessary to accommodate from three to six men, and the equipment of machines, which consisted of a band saw, a jointing (a "buzz") planer, a surface planer, a circular saw (provided with both cross cut and rip saws), a large and a small lathe, the former provided with an overhanging face plate for large work, while the smaller one was practically a small speed lathe.

One other condition had to be reckoned with—the line shafting ran in line parallel to the length of the space, so that either new shafting would have to be put up or the machines set crosswise of the shop. The practical pattern-maker will realize what this means, with reference to the circular saw and the surface planer which must frequently work up lumber 16 feet long, when he considers that the entire space is but 24 feet wide.

However, by proper arrangement of the facilities at hand, a very convenient and comfortable little pattern shop was obtained, and is now in efficient use. It is the purpose of this article to show how it was done.

Fig. 1 is a plan of the shop as finally arranged. It is 24 x 60 feet, and has a line shaft running the entire length, nearly over the small lathe and just inside the partition. The elevator shown on the plan is situated midway across the end of the floor and furnishes a convenient means of bringing in lumber and of moving patterns in and out.

The obstructions encountered in carrying out a plan was the elevator and the necessity of a clear passage from it through the center of the floor and a line of posts 18 feet from the sidewalk and 15 feet apart. The first limited the width of the pattern shop, while the second had to be avoided in locating the machines.

In order to run long boards through the principal machines set crosswise of the shop, openings were left in the partitions opposite each one and at a proper height, as shown by dotted lines. To prevent sawdust and chips from flying through these and into the shop, a matter strongly objected to by the insurance companies, these openings were closed by doors hinged at the bottom. These openings were 18 inches high and as wide as the capacity of the machine rendered necessary. Near the elevator are double doors, opposite to which is a clear space between the machines for taking patterns in and out.

A work bench occupies the entire length of the room at the outer wall and furnishes sufficient space for five patternmakers on ordinary work. A work table 4 x 8 feet is located near the foreman's corner and near it the band saw. The large lathe is located with its head toward a window, so as to afford ample light when doing work on the overhanging face plate. The small lathe is set close to the partition, as much out of the way as possible and yet near enough to the large lathe to be convenient to the tools in use upon it.

Opposite the surface planer and circular saw is a large work table 4 x 16 feet and built low enough to permit long boards worked in these machines to pass over it. Next to this is a floor space 13 x 15 feet, where large patterns may be handled. This disposition and the space afforded is ample, as no very large or very long patterns are made.

Across the end of the room near this space is a series of shelves upon which may be stored small patterns, many of which are made and many more brought in for alteration and repairs. The varnish bench is located here, this corner being usually devoted to the finishing and varnishing of patterns that may be handled by an apprentice.

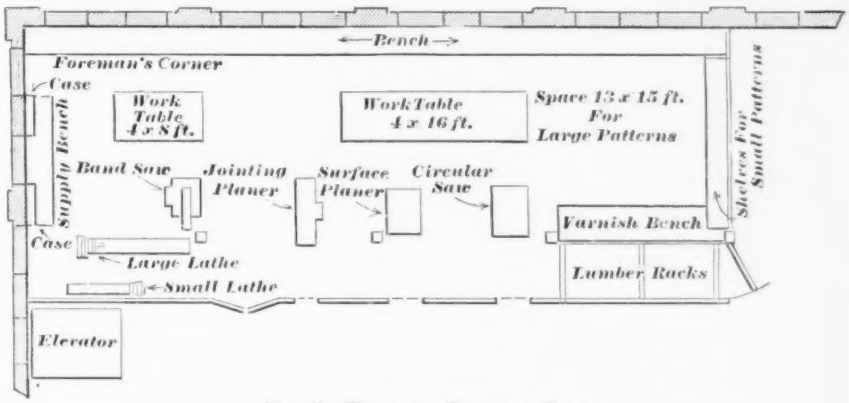


FIG. 1—PLAN OF PATTERN SHOP

In the patternmaker's bench, along the front wall, are the usual drawers, one large and one small one for each man. The small drawer is used for such small articles and tools as may be most frequently needed, while in the larger drawer is stored more bulky and less frequently used tools, etc., while on the walls between the windows are the tool cases of the men and suitable shelves upon which may be placed such articles as brads, screws, etc., and by which arrangement the bench space is saved from unnecessary litter and rendered available for its legitimate uses as a *work* bench.

Pattern shop supplies cost a considerable amount in the course of the year, even for a very moderate sized shop, that is, if these goods are first class, and it is very short sighted policy to purchase an inferior grade with the idea that it is economy. Consequently, it becomes a matter of considerable importance how we store, care for and issue these supplies, and right here we may find the legitimate field for practicing economy.

In this case the foreman's corner is one provided with ample light and conveniently located for arranging suitable means for storing such supplies as are needed in the shop. Fig. 2 shows the supply bench and cases built and provided as follows: The bench, proper, is built of the usual height 12 feet long 30 inches wide. At the left hand end a space 10 inches in height, the width of the bench and four feet in length is occupied with pigeon holes for holding wood and leather fillets and wood dowels. Beneath this is formed fifteen boxes for holding rapping plates. At the right hand end is a cupboard 18 inches deep, opening at the end of the bench and having one shelf—this is used for holding alcohol cans, shellac jars, etc. To the left of this space is provided for six shallow drawers properly divided for storing pattern letters and figures. Next to these are three large and deep drawers where bulky packages and surplus articles may be stored. All these compartments are protected from dust except those for the rapping plates and the ends of the fillets, which latter may be covered by a door hinged at its lower edge, if desired.

This supply bench is located under a

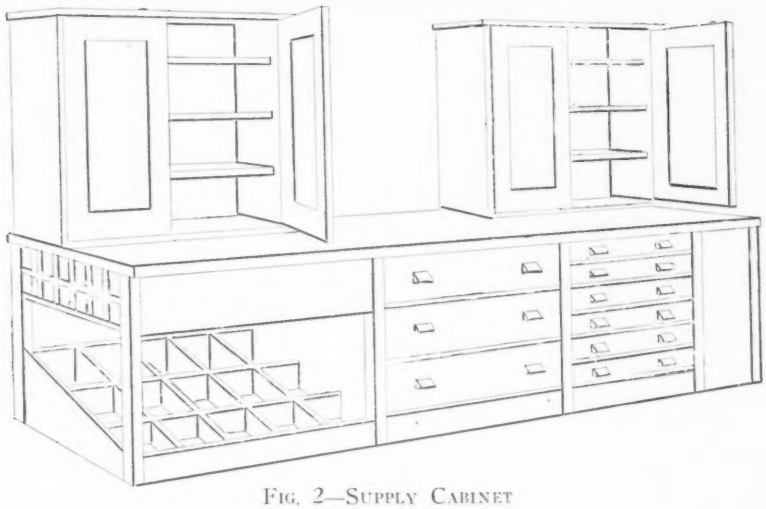


FIG. 2—SUPPLY CABINET

window which occupies a space equal to one-third its length; consequently, it is not possible to build cupboards or shelves through the entire length. Therefore, two cupboards are built each four feet wide, three feet high and 12 inches deep. These are closed by double doors and provided with shelves suitable for storing such articles as brads, wood screws, glue, shellac, sand paper, dry colors for making colored varnishes, beeswax, brass dowels and a variety of similar articles. Lamp black must be kept in a closed sheet metal can and in some open place where it can have plenty of air and be readily seen, on account of its liability to spontaneous combustion.

Pattern lumber of a good quality is difficult to find, expensive to purchase, requires considerable care in its preservation in proper condition and should be used with due regard to economy. It was from considerations similar to these that the lumber racks shown in Fig. 3 were designed and built. As will be readily seen, it would be awkward and inconvenient to carry lumber in through the double doors, and the plan of piling the lumber on its flat sides, even with the various pieces separated by thin strips, would so place it as to be very inconvenient to get at certain thicknesses that might be in the middle or bottom of the pile; again, no lumber is in as good

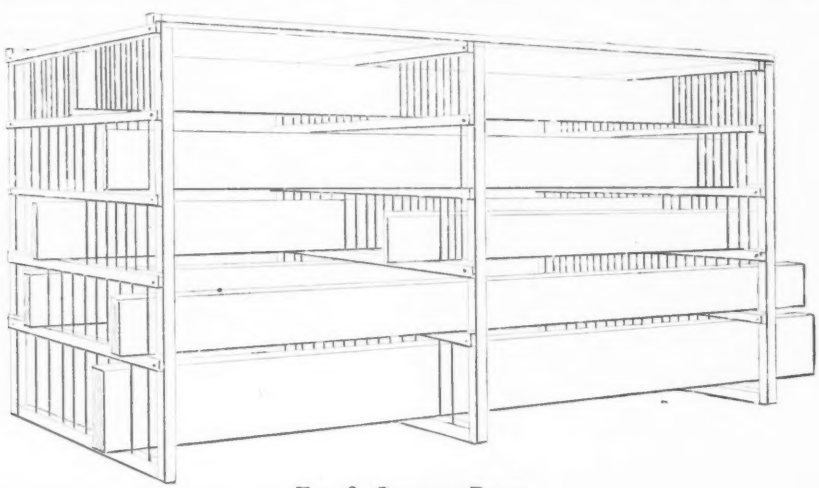


FIG. 3—LUMBER RACK

a condition when resting on its side as upon its edge. By placing the thickest lumber at the bottom of the rack and graduating to the thinnest at the top, the weight is properly distributed and the labor of putting in and taking out the planks and boards very much reduced.

This lumber rack is composed of three frames, each about six feet wide and six feet high, composed of sides and base of 3 x 3 spruce and having five cross bars of 2 x 3 spruce bolted to them, as shown. Between these cross bars are vertical pieces of half-inch, round iron, whose upper and lower ends rest in holes in the cross bars. In this case the rods at the top may be long enough to pass through the upper, the second and into the third cross bar. The third and fourth space may be constructed in the same manner, while the rods of the bottom section should be considerably farther apart, so as to admit four-inch planks. Those at the top may be not over three-quarters of an inch apart. It will be found advantageous to plane the lumber to certain regular thicknesses as soon as it is received, as this will permit it to season better, and although the lumber is purchased as kiln-dried lumber every patternmaker is well aware how little fitted for good pattern work most of this lumber is when he gets it.

The three frames described are placed six feet apart, fastened to the floor and the partition and secured at the top by the long upper rails, as shown. This rack, being located at the corner of the room permits convenient access through the door at the end for introducing lumber, and the opposite end being open to the pattern shop permits its ready removal.

By enclosing this rack on the inside and top, providing a tight door at its inner end and supplying it with a steam coil under the lumber, a very efficient and economical dry room may be produced.

The general plan and arrangement of this pattern shop is submitted, not only as one that has answered admirably under the somewhat adverse conditions which rendered its design necessary, but as having several very practical features that may be incorporated in the design of a shop under more favorable circumstances. Among these may be mentioned the form of lumber rack and the supply bench and their location with reference to the other component parts of the design. The object is, of course, to so arrange these that while all the machines are conveniently near the workmen and each other for practical use, they shall not be so arranged as to obstruct or injure the efficiency of the workmen in their regular duties.

SHOP KINKS OR SHORT CUTS, AND DONT'S*

BY THE CLEVELAND CLUB OF ASSOCIATED PATTERNMAKER FOREMEN

IN NO trade, more than in patternmaking, does the individual have the opportunity to develop his original ideas and carry them to a successful issue, yet there are many patternmakers that are content to follow precedent and do certain jobs today in a certain way just because they saw some one else do a similar job in like manner years ago.

It is the object of this paper to keep the patternmaker thinking along new lines, to show this by a few examples, and to impress it particularly by a series of "don'ts."

For instance, we may say, "Don't forget those simple geometrical problems that you learned years ago while at school (we used the term years ago advisedly) that you may need today." But don't always follow the roundabout way of working that may

*Presented at the Philadelphia convention of the American Foundrymen's Association.

have been taught you by the professor. How many patternmakers waste time and brain power, for instance, struggling with the simple problem of striking the ellipse.

Striking an Ellipse.

Various and curious have been the devices contrived for delineating the contour of an ellipse, and the fact does not seem to be universally known that the true way is the simplest. Fig. 1 shows how this can be done with the ordinary steel square, or in fact almost anything that is handy, having two of its edges at right angles, and a thin

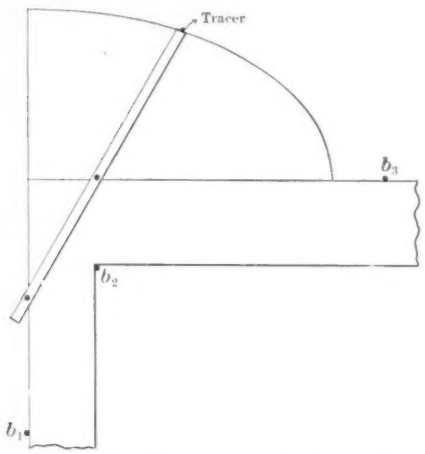


FIG. 1—STRIKING AN ELLIPSE WITH A SQUARE AND TRACING BAR

stick, about ¼ inch x ½ inch, a little longer than one-half the major diameter of the ellipse.

Take the pieces on which you wish to lay out the ellipse, mark off the center lines, also the major and minor diameters, transfer the lengths of the semi-major and semi-minor diameters to the stick, driving in two fine brads at these points. Next, place the square on the center lines, the intersecting outer edges at the center of the ellipse, drive in three small brads as shown at b1, b2, and b3, which will secure the square in position. Then, placing the stick in position the two brads will project through the under side slightly less than the thickness of the square bearing against the two outer edges, move carefully to the right and the tracer will mark out one-quarter of an accurate ellipse. The draughtsman can do the same thing on his drawing by utilizing his set square or triangle and thumb tacks, two pins and sliver.

Different Application.

Fig. 2 illustrates the same principle, the application being slightly different. Take a piece of wood, large enough to make one-quarter of the ellipse, trim off one end square with one edge, place the end against the edge of another piece of the same thickness straight on one edge, and brad them lightly to the table. Take a narrow strip and drive two brads through it as shown in Fig. 1. Placing the tracer

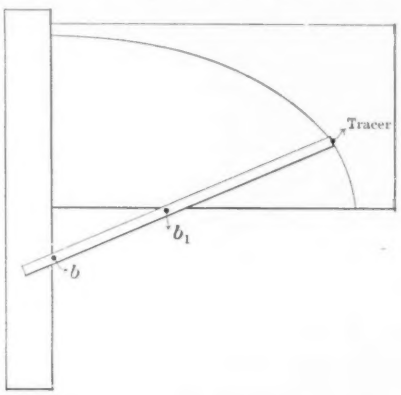


FIG. 2—STRIKING AN ELLIPSE WITH TWO PIECES OF WOOD AND A TRACING BAR

at the end of the stick, draw to the right, allowing the brads to slide closely on the inside edges of the two pieces of stick, and the result is the same as secured by the first method; by simply reversing the pieces you can get the other parts, or you can cut out the quarter and use it as a templet. It is exactly the same as an ellipsograph and just as accurate; but how often do you rub against a patternmaker with one in his kit? Some are minus other things more essential than an ellipsograph, but a few brads and a stick are always at hand.

Fig. 3 is an illustration of turning up in the lathe an elliptical valve which will fit accurately in a circular pipe at an angle of 45 degrees. Having the

diameter of the pipe, which is the minor diameter of the ellipse, ascertain the major or long diameter by laying out the angle; cut out of a piece of stock an approximate ellipse the required thickness of the valve, leaving sufficient stock on the edges for turning off; then take two pieces large enough to take in the butterfly and tail stock centers and of sufficient length and rigidity, fasten them securely in the center of the piece for the pattern, at an angle of 45 degrees, center the ends and proceed to turn. It is not as difficult as it looks, the dotted lines in the sketch showing the exact contour of the edge as the piece revolves, and with a modern screw feed

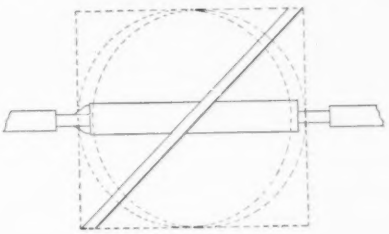


FIG. 3—TURNING AN ELLIPTICAL VALVE

lathe, would be easy. This is a very quick way and will insure a perfect fit in the pipe.

Fig. 4 is a fairly good approximate layout of an ellipse by the divider route, a b is the major and c d the minor axis of an ellipse. Space off b e equal to the semi-minor axis c o, using a e as the radius for the arc at each end of the minor axis. Bisect e o at f and space off eg equal to ef and use gb as radius for the arc at each end of the major axis. This is a very good approximate method, very nearly approaching perfection when the difference in length of each axis is not great.

Arcs of Circles of Large Diameter.

To strike the true arc of a circle whose center is inaccessible, or whose radius is so large that it is not practicable to strike it by means of a long trammel or rod, there is nothing to compare with a steel tape, using a chalk line for the radial lines. Fig. 5 is illustrative of a method which is accurate and also easily applied. It represents the three curves necessary for the layout of a bend pipe of a large radius. Having the chord line it is first necessary to find the versin or the rise in the center, which may be done by using the following formula:

$$\frac{d - \sqrt{d^2 - c^2}}{2} = \text{versin.}$$

Reducing this to shop lingo, it reads from the square of the diameter subtract the square of chord, then extract the square root of the remainder; subtract that from the diameter and divide by two. The answer is the rise or versin.

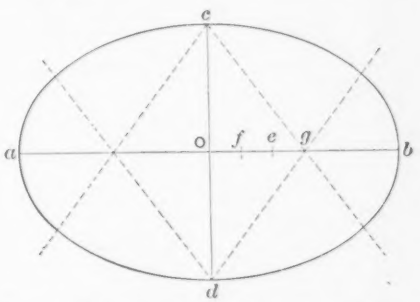


FIG. 4—APPROXIMATE METHOD OF DRAWING AN ELLIPSE

Next it is in order to cut a board in the form of a triangle, the base being the chord line as shown at a b, the apex at c. You will note from the sketch that it is necessary to extend the ends of the triangle at a and b, which is done by making the base line one inch below the chord line, parallel with it. In order to strike the three curves from the one triangle, it will be necessary to screw onto this piece a narrow strip in the center at right angles to the base line, as shown at c, its length equal to the diameter of the pipe. Having laid out the center chord line, place the triangle in position, driving into the table or layout board three brads as shown at b1, b2, and b3. Place the tracer at either point as marked and move to the right or left, taking care that the base of the triangle remains in contact with brad marked b2, and if to the right with brad b3, or if to the left with b2 and b1. The tracing point will delineate the

true curve, and you will not have to go out on the street or require the area of a 10-acre lot to do it in, as we are informed has been necessary in some cases.

Advice for the Patternmaker.

To the patternmaker, we would say, don't be a shop knocker, but make the best use of the tools at hand; remember that only a very few shops are up-to-date.

When speaking of an up-to-date shop, most of our mechanics of today imagine that a shop of this kind must be equipped with a lot of new machines that most of them have never seen, or that take an age to learn to operate.

It never will occur to the workman that he himself should be an up-to-date mechanic, with new ideas, and that he should add to that ancient shop which has, perhaps, for years buttered his bread to his satisfaction. Instead, he often curses the old place as not being up-to-date, and characterizes his employer as being too tight-fisted or too selfish.

The old saying is that there is no ocean so deep but that it has a bottom. The failure of the old shop in not putting out work to compete with others is not always due to the employer's selfishness. But getting down to the bottom is due to the workmen employed in such a place, for can you find such a shop-knocker that will even try to make the best use out of that machine which he already has?

Old machines are not always scrap or useless, just because there is a more modern one on the market; a little study given to the old machine will certainly improve it. For instance, take an old cross-cut saw table in running condition in a pattern shop where the table has not been graduated so that octagon, hexagon or miter or other degrees can be cut on it, by placing the guide in position. This table is easily improved and made equal to the modern ones by simply applying a piece of board on which the segment of 90 degrees is laid out as shown in Fig. 6.

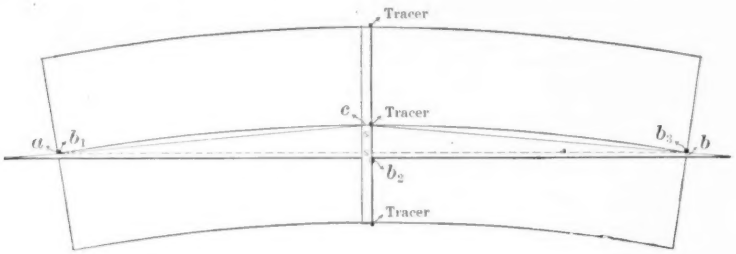


FIG. 5 —DRAWING AN ARC

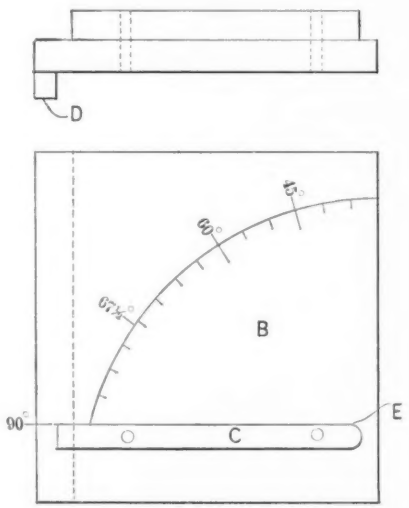


FIG. 6—GUIDE BOARD FOR THE SAW

To correctly make this board is simple. Take a board jointed and of parallel thickness the full width of the table, and place it at the left of your saw; screw or nail strip D as shown in Fig. 6; place in slot as shown in Fig. 7 and rip off to width. This done,

take it to the bench and square from the ripped side and lay out the segment as shown in B, with the center a convenient distance from edge so that guide C can be seen crossing it.

This guide has two pins to steady it in different positions, without interfering with the edges; the one far enough in from the center, so as to allow a number of holes on the different degrees in board B.

Place this guide piece on the different degrees on board B and bore from guide C through board B. Put dowel pins in the guide C and the improvement is complete for any straight work to be cut to any angle.

The work is not always of a straight nature and curves must be cut on angles of different degrees, as segments for rings, sometimes in quarters, sixths, eighths, twelfths, or any part of a circle. This is very hard for most workmen, and many of them waste more time in trying to butt these together than it should take to complete the work.

With a simple improvement to our first device, this can be done very easily in about one-tenth the time required for any other way and all hard labor will be avoided and a better joint will be made.

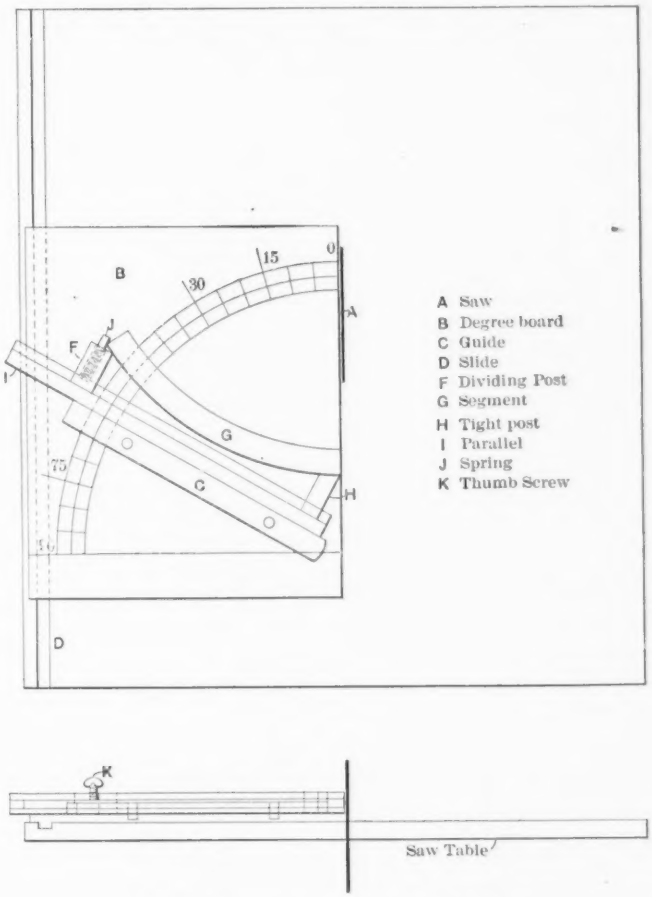


FIG. 7—BOARD APPLIED TO SAW TABLE

Another Improvement.

Improvement No. 2 can easily be added at a very small cost to the employer. This consists of a straight and parallel piece as shown in Fig. 8,

placed on the device shown in Fig. 6 at the desired degree. It is easily made by the following method:

Take a straight and parallel piece as shown at I, Fig. 8, of any thickness, and rip a tongue of about 1 inch on edge. Take two pieces marked F and H, Fig. 8, of the same thickness about 4 inches long and 2 inches wide, and groove to take tongue of piece I, cutting and fastening piece H tightly to piece I, as shown; then in F place an old style window spring by boring a hole at J in F, as shown. Get a thumb

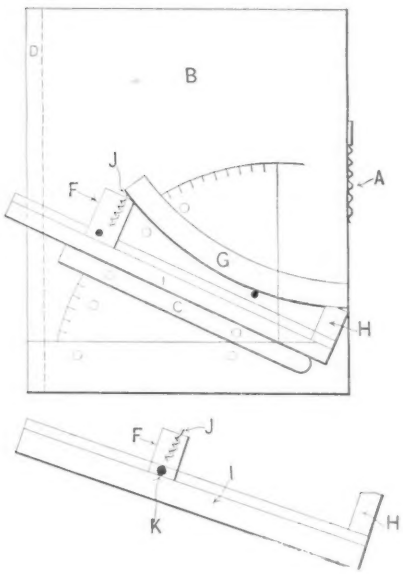


FIG. 8—ATTACHMENT FOR SEGMENT WORK

screw K and nut to fit it, cut a notch in the groove to receive the nut, and bore a hole that the thumbscrew will take the nut in the notch and tighten down on the tongue in I.

In using it, the segment is first sawed on the band saw to the size required. A chord is found corresponding to the number of segments wanted for the circle; the length of the chord is made the distance between the spring piston J in F and the cutting point of saw or face of post H. The first cut of the proper degree is made with the spring drawn in with the segment as shown in Fig. 8. The other end or length is cut by bumping the end already cut against the spring piston as shown in Fig. 9.

Cheap Sanders.

Another very useful labor saving device for this curved work is a cheap sander, which can also be rigged by the employe without great cost, as the lathe in the shop can be used.

Take the extra face plate, screw a disc to it, true up the face and turn to about 10 inches diameter; then get a sheet of coarse sandpaper and four pieces of leather or rubber about ¼ of an inch square; place your paper on the disc, first dampening slightly on the back, and bend the corners over the edge of the disc and tack it on through the leather or rubber. By placing a block on the bed within ¼ of an inch of the disc, and just to the center of head of lathe, so that it can easily be removed and also tilted, it is ready for work.

This rigging can be used to good advantage for making a number of tail prints, discs, segments, round prints and small flat surfaces.

Band Sawing to the Line.

Don't start your job until you have it well in mind, or you may strike a snag later on.

Don't proceed with the pattern without noting the metal of which it is to be cast.

Don't fail to inquire whether the grade of pattern is temporary, medium or standard.

Don't forget that the art of quick pattern making lies in knowing where to slight it,—but

Don't form the habit of slighting everything. The man that can work according to his job is a valuable man.

Don't trouble the boss with fool questions. He has troubles of his own, besides you may expose your ignorance at the same time.

Don't try to get along without really necessary information on the job at hand, which the boss may have neglected to give you.

Don't make unnecessary layouts of work.

Don't take time to lay out a job, then not use the layout; properly used, it will save time on the job.

Don't fail to study economy both of material and time; both cost your employer money.

Don't miss checking up all dimensions on the drawing before proceeding with pattern.

out the floor between your bench and the old man's desk.

Don't construct large patterns without provisions for handling, shipping or storing.

Don't be stingy with your core prints.

Don't be afraid that well defined center lines will spoil the looks of

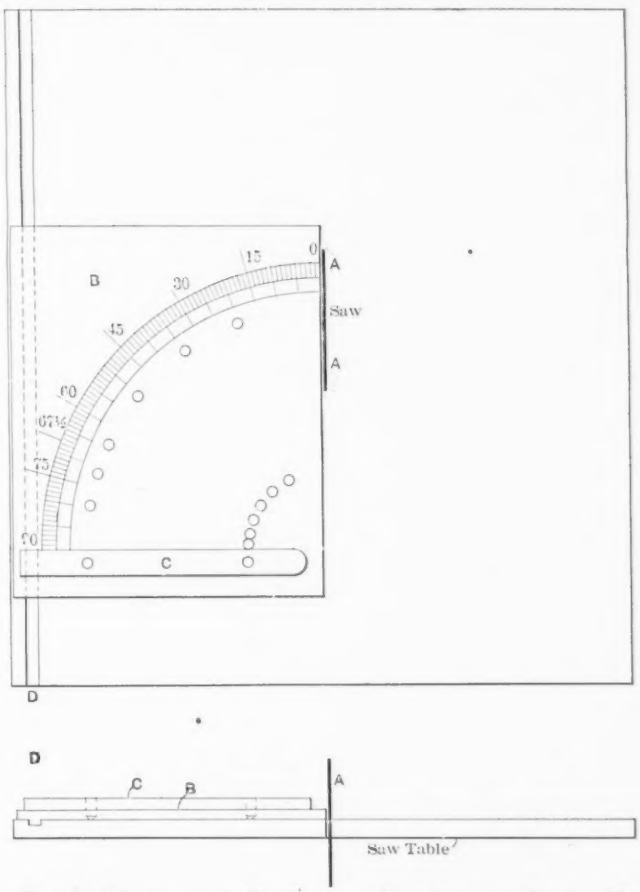


FIG. 9—DEVICE WITH SEGMENT IN POSITION FOR SECOND CUT

Don't make a pattern without knowing how it is to be molded, simply because the old man told you to do so.

Don't accept your first inspiration as to the molding and construction of a pattern; try and think out another way.

Don't start a job you don't see through, expecting to get an inspiration as you go along. This idea wears your job. They will look good to the checker, and to the lad who may have to change the job later.

Don't fail to put center lines on your core boxes, as well as your patterns. A pattern like bread that is cast on the waters, is seen again after many days, and it may be up to you to change it.

Don't look as pleasant as a calf's

father, when the boss gives you a disagreeable job. Do it cheerfully, and if you think he is rubbing it in, you can always quit; and if he really is, you had better.

Don't pick out all the snaps for yourself, when you have help on a job. However good you may be—

Don't forget there are others.

Don't despise the help of the apprentice on the job. He did not come in simply to learn to varnish, so let him do things. If he falls down, pick him up, and—

Don't forget you had your troubles, and when you are a has been, he may help you.

Don't think that you know it all;

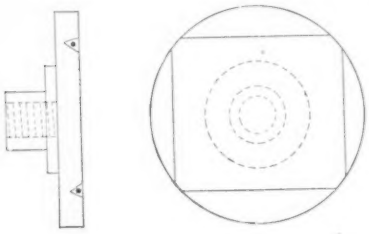


FIG. 10—HOME MADE SANDER

there are other men that know a little.

Don't do by hand that which the machine should do, but you—

Don't have to wait your turn at the band-saw to cut off a toothpick.

Don't fail to study your machines and how to get the most out of them, but—

Don't take liberties or long chances with the jointer, especially when the knives are dull; better a few shavings round your vise than a crippled mitt.

Don't take long chances on the lathe, remember the adage, "An ounce of prevention is worth a pound of cure."

Don't waste time setting bevels for standard cuts that are arranged for on the saw table or trimmer. A little mental calculation and the indicator is better.

Don't think because you see a circle on the drawing that the work must be done in the lathe; other pieces fit sometimes, and

Don't forget that a sharp band-saw is a good tool, and sawing to the line not quite a lost art.

Don't use your material for a footstool before working it up. It's hard on the machines.

Don't wait until the rip or bandsaw is just sharpened, then saw nails; if it must be done, do it before.

Don't swear when your plane hits a nail. The chances are you put it there yourself.

Don't sandpaper each piece as you put it on the pattern, then plane it afterwards. It takes time to sharpen tools, and—

Don't forget to buy your own.

Don't round up the ribs and corners of a pattern until all pieces have been assembled.

Don't throw too much work on the foundry, but occasionally a little stopping off saves time.

Don't leave the making of the stop-off piece to the foundry carpenter; he may not see things as you do.

Don't glue cross grain, for a distorted pattern is very apt to be the result.

Don't glue two pieces of wood together that have just come out of the ice box. It's too chilly on the glue.

Don't carry your tools in a collar-box and expect the steady pins to furnish the ones you haven't got.

Don't borrow tools and forget to return them, and especially

Don't borrow when the other man is not looking.

Don't go to work so loaded that everything appears double. It's hard to guess the right thing. This applies only to a few.

Don't assume any pattern is correct; treat them all with suspicion until proven.

Don't proceed with the alteration of an old pattern, without first carefully checking it up.

Don't proceed with another workman's job without checking his measurements.

Don't use screws when nails will do the work as well; nails go quicker and are cheaper.

Don't forget that supplies and lumber cost money; if the other fellow is paying for them—so

Don't fail to practice economy, and

Don't lug in a 16-foot plank and cut a 4-inch or 5-inch print out of the middle; it's easier to turn over the scrap pile.

Don't keep your bench so littered up that it takes five or 10 minutes to find some small tool you just laid down.

Don't think because you happen to be a relative of some member of the firm that you are entitled to more privileges than any other man.

Don't try to do as little as you can for the most you can get, and—

Don't do any fooling during working hours; you are paid for working—not playing.

Don't fail to report promptly when your job is completed.

Don't stand around and look wise when waiting for a job. Get busy with your oil-stone. There are always tools to be sharpened.

Don't fail to check up your pattern when complete.

Don't leave your mistakes for others to find; find them yourself, and if you do—

Don't let them go on a chance of its getting past the checker. Be sure your sins will find you out, even if it does rope in the other lad.

Don't say "that is near enough."

Don't fail to number and place location marks on all loose pieces of pattern and core boxes.

Don't forget to place a marker upon the core print, if the core can be reversed.

Don't fail to nail the lead letters and numbers on the pattern. One nail in each letter is not enough to insure them staying right side up.

Don't number the core boxes upon the face of box; sand in time will wear it off.

Don't size up your job and guess at the amount of lumber; keep account of the boards as you cut them up.

Don't forget that an easy way to figure lumber is to multiply the length in feet by the width and thickness in inches, and divide by 12. Example: 9 feet x 8 inches x 1½ inches ÷ 12 = **9 feet.**

Don't forget to mark upon the side of core boxes which way lifting hooks for the cores are to be placed.

Don't forget to mark the length of standard cores upon the pattern, when used. This saves the molder's time, as well as the core maker's.

Don't waste time doing unnecessary work.

Don't spend time and money giving patterns a piano finish. They are not used for ornaments.

Don't get into a rut of doing any certain work; try and improve upon your method, as well as lessen the time.

Don't think you know more than the boss, even if you do.

Don't expect the highest wages, unless you can produce the goods.

Don't make a practice of being late at work.

Don't do government work in the company's time.

Don't keep one eye on the boss and another on your job; it's difficult to watch them both.

Don't take off your apron and look for a chance to wash up before quitting time.

Don't dig ditches in the grindstone.

Don't touch a broken band-saw until the machine has stopped running.

Don't leave the jointer with a heavy cut on; run the table up.

Don't make the final calipering of your work while the lathe is running.

Don't use double-ended turning tools, they are dangerous.

Don't forget that a tooth plane bit makes an excellent turning chisel for straight work.

Don't forget that dowel pins belong in the cope half of pattern.

Don't fail to secure your work well in the lathe either between centers or in the face plate.

Don't stand directly in front of the rip saw, when sawing; they sometimes kick.

Don't provide bottom boards for core boxes unless necessary; they are often a waste of time and material.

Don't fail to make the necessary provisions for rapping and drawing the pattern.

MANGANESE IN CAST IRON*

Discussion of the Effects of the use of this Alloy—Increases Carbon and Decreases and Neutralizes Sulphur

HERBERT E. FIELD

THE literature in regard to the effect of manganese in cast iron contains many contradictory statements. As is usual in such cases, these statements were correct for the work with which the writers were familiar. The errors come from drawing general conclusions from special experiments. Four years ago, in a paper before your association, I called attention to the confusing statements in regard to carbon in iron. I then cited two opposite statements made by different authorities and showed that both were correct in the limited area of their experiments. Today I wish to reconcile the diverse opinions in regard to manganese in cast iron.

Effects of Manganese on Hardness.

One authority states that manganese hardens iron, while another as confidently asserts that it has a softening influence. Both are correct. There are two conditions which determine the effects of manganese on iron; first, the percentage of sulphur present and second, the amount of manganese. These two conditions are so bound up with one another that it is almost impossible to consider them separately.

Manganese tends to increase the per cent of total carbon; to increase the amount of carbon held in the combined condition; to decrease the sulphur; and to neutralize the effect of the sulphur.

Action of Manganese in Increasing Carbon.

Manganese itself will hold more carbon in combination or solution than will iron, hence, an increase in the per cent of manganese in an iron tends to increase the carbon. This is especially true in cases where the manganese is added to the ladle as ferro-manganese or spiegel, since the per cent of carbon in these two increases the per cent of carbon in the whole. When the manganese is charged into the cupola, it acts in two ways to increase the carbon. First, it partially prevents the carbon from being oxidized when the iron passes through the melting zone of the cupola, and second it increases the absorption power of the iron for carbon and hence, the iron in passing through the incandescent coke, will absorb more carbon. The higher the manganese present, the greater will be the amount of carbon so absorbed. In the paper above referred to, I pointed out that, other things being equal, the higher the total carbon, the softer will be the cast iron. An increase in the manganese then, tends to soften the iron by increasing the total carbon.

Action of Manganese in Increasing Combined Carbon.

The softening tendency, due to the manganese raising the total carbon, is to a certain extent, counter-balanced by the action of manganese in forming combined carbon. This combined carbon is not the hardening carbon which gives the intense hardness to quenched steel but is a definite compound of manganese and carbon. The carbon so united is called carbide-carbon. It

*Presented at the Philadelphia convention of the American Foundrymen's Association.

is this tendency to form a hardening carbide that has led many to state that manganese hardens cast iron. The hard, gritty nature of some high manganese irons is due to this carbide. We are all familiar with the high manganese pig irons which have a dark, open No. 1 fracture, which, even to the expert eye, would be graded as a number 1. When we try to drill this iron, we find that it is almost impracticable to do so with any ordinary drill and with specially hardened and shaped drills, it grinds rather than cuts. This peculiar nature of high manganese iron which makes it so hard to drill is due to an innumerable number of small particles of this very hard carbide.

Action of Manganese in Decreasing Sulphur.

It has long been known that manganese tends to eliminate sulphur from iron in passing through the cupola. This elimination is due to the fact that manganese forms a compound of sulphur which separates out of iron at a high temperature. This temperature is above the melting point of iron and hence the compound passes off into the slag. Sulphur hardens iron and, as manganese tends to eliminate sulphur, it has a decided softening influence upon the iron. This influence, of course, is an indirect one, as it is due to the absence of the sulphur rather than to the presence of the manganese.

There has been considerable discussion in the last few years over the value of manganese ore as an eliminator of sulphur in cupola work. Some German experimenters have stated that a large proportion of sulphur may be removed by the correct use of manganese ore and limestone. Some of our American foundrymen working on the same lines, have obtained results which are not nearly so convincing. Many reasons have been given for this discrepancy in results and the prevailing opinion seems to be that the difference is one of temperature. The use of manganese ore in cupola practice is open to several objections and as high manganese iron can be readily obtained which will introduce the manganese in a very satisfactory manner, the former method is hardly to be recommended for ordinary cupola practice.

Notes on Previous Work.

A few notes on previous work on this subject might be of interest. A. E. Outerbridge, in a lecture before the Franklin Institute, in 1888, called attention to the remarkable effect of the addition of a small amount of manganese to a ladle of cast iron. Prof. Turner, the English metallurgist, states that manganese eliminates the sulphur as in manganese sulphide which floats on the surface of the molten iron, thus forming a part of the slag which collects at the top of the metal.

Walrand melted cast iron high in sulphur in one crucible and manganese in another crucible and when the two were poured together, a strong odor of burning sulphur was given off. The sulphur was reduced from 0.5 to 0.06 per cent.

Caron's experiments along the same line gave the same result and he is said to be the first to call attention to this peculiar feature of manganese, in its action on sulphur.

J. W. Stead melted 100 parts of ferro-manganese with sulphide of iron in a crucible. The metal produced showed 0.02 per cent sulphur while the slag analyzed 28 per cent sulphur and 56 per cent manganese.

The Action of Manganese in Neutralizing the Effect of Sulphur.

We have noted that the effect of manganese in eliminating sulphur was due to the formation of a sulphide of manganese which floated to the top of the iron and formed a part of the slag.

Prof. Le Chatelier and Mr. Ziegler first suggested that this effect was produced by the segregation of sulphide of iron at a temperature above the melting point of iron.

Effects of Sulphur.

The effects of sulphur on iron are

too well known to be discussed here. It makes iron short, brittle, and hard. Excessive amounts make it very weak. These effects of sulphur are due to the fact that when cast iron solidifies, the sulphur is still in a gaseous state and each particle of iron is surrounded by a wall of gaseous sulphur. When the iron cools, the gas solidifies or unites with the surrounding crystals of iron as iron-sulphide. In this latter condition, it occupies much less volume than when it was in the gaseous state. This leaves the crystals of iron surrounded by small spaces which, under the microscope, have the appearance of very minute cracks. These cracks give to the iron the brittle, short property characteristic of high sulphur iron.

The point to be borne in mind in this connection is that the sulphur is in the form of a gas when the iron sets.

Let us go back for a moment and consider the effect when manganese was added to irons high in sulphur. The manganese united with the sulphur and the sulphide of manganese separated out at a temperature above the melting point of iron or, in other words, while the iron was in a liquid condition so that when the iron solidifies, there will be no sulphur left as a gas to form microscopic cracks, it having already united with the manganese to form sulphide of manganese. The bad properties due to high sulphur would, therefore, be removed. In place of the gaseous sulphur, we have present a sulphide of manganese which will rise to the top of the iron as a slag, provided sufficient time is given for it to do so. If, however, there is not sufficient time, the sulphide of manganese is held in the iron in suspension, in the form of infinitely small, solid particles. These are invisible to the naked eye and do no more harm than so many particles of any solid substance.

There are times, however, when the casting remains liquid for a long time that this sulphide of manganese will segregate together towards the top of the casting and form bad spots which are difficult to obviate and which are frequently blamed to very different causes.

In spite of the fact that the effects of sulphur on steel and the effects of manganese on sulphur have been known for a considerable time, it has only been within a comparatively short time that this knowledge has been applied in a practical way, or that the facts have been brought together and a lucid explanation given of the cause and effect of the additions of manganese to steels high in sulphur. The credit of bringing this subject again to the attention of metallurgists is due to J. O. Arnold.

While working on a sample of steel rail high in sulphur, furnished by Mr. Brinell and recorded as giving good results, he discovered that instead of the fine, microscopic cracks which would be expected from so high sulphur percentage, that the steel showed in place threads of what appeared to be slag running length-wise with the rail. This was manganese sulphide and proved to be no more harmful to the rail than the fine threads of slag contained in wrought iron are to that product.

If we apply this to cast iron, we find the same conditions exist. The effect of manganese on cast iron, which has not previously been explained, under the light of this knowledge becomes clear. The statement that manganese softens iron is readily believed when we appreciate that it forms a compound with the sulphur thus removing its hardening effect. The strengthening effect of manganese is easily explained when we consider that it removes the small, microscopic cracks caused by the sulphur.

It is very readily proved that manganese does unite with sulphur to form the sulphide of manganese in cast iron. It is not possible to separate it from iron by analysis but its tendency to rise to the top of the casting gives us a desired opportunity to prove our question.

Chas. H. Risdale gives the analysis of an ingot mold which showed in the top part 1.35 per cent manganese and 0.75 per cent sulphur, while the bottom part of the same mold showed 0.11 per cent sulphur and but 0.54 per cent manganese. An analysis recently sent me of a cylinder but 24 inches long and 9 inches in diameter gave the following analysis for sulphur and manganese at the top and bottom of the cylinder:

2 in. from bottom..Sul.0.148 per ct. Mang.0.54
½ in. from top....Sul.0.204 per ct. Mang.0.66

It will be noted that this cylinder was but 24 inches long and that the time taken for it to solidify would be comparatively short and hence the time allowed for the sulphide of manganese to rise would be of a very short duration.

The top of a water pipe cast on end gave sulphur 3.06 per cent, manganese, 1.136 per cent, while the bottom end showed but 0.076 per cent sulphur and 0.584 per cent manganese. The top of another pipe gave 0.43 per cent sulphur and 1.79 per cent manganese, but, unfortunately, no piece from the lower part was saved. These show a simultaneous segregation of manganese and sulphur from molten iron. Inasmuch as manganese would not be expected to segregate by itself, it would appear that this compound must separate out and rise to the top of molten cast iron.

The writer considers that this explanation of the effects of manganese on cast iron reconciles the conflicting statements in regard to the same. It explains the segregation of sulphur and pig iron which has long been known but never explained. It shows why sulphur makes iron weak and that when united with manganese, it has practically no weakening effect on iron. It explains the remarkable effect of small amounts of manganese when added to a ladle of cast iron. It shows why high manganese may cause dirty iron.

NEW ENGLISH BRASS FOUNDRY REGULATIONS.

To promote more healthful conditions in connection with the casting of brass, the English Home Secretary has issued a draft of new regulations proposed for enforcement. They provide that the casting of brass shall not be carried on unless there is an efficient exhaust draft for the removal of the fumes at or as near as possible to the point of origin; an efficient arrangement to prevent the fumes from entering any room in the factory in which work is carried on, and free openings to the outside air in the upper part of the room. A lavatory should be provided under cover, containing a sufficient supply of clean towels, renewed daily, and of soap and nail brushes, and with a trough with a smooth impervious surface fitted with a waste pipe without plug, and of such length as to allow at least 2 feet for every five persons, having a constant supply of warm water from taps or jets at intervals of not more than 2 feet. No female shall be allowed to work in any process whatever in any room in which the casting of brass is carried on.

The employes are enjoined from leaving the premises or partaking of food without carefully washing their hands. In an accompanying circular it is stated that the new regulations have been prepared after careful inquiries, extending over a period of several years, into the condition of the industry.

ELECTRO-DEPOSITION OF ZINC.

In a paper entitled, "The Electro-Deposition of Zinc," read at the annual meeting of the Electro-Chemical Society of Philadelphia, Ralph C. Snowden concludes with the following summary: More finely crystalline deposits are obtained from alkaline than from acid solutions. Increasing temperature or concentration increases the size of the crystals. Presence of formaldehyde decreases the size of the crystals. Increasing the current density decreases the size of the crystals.

BRASS FOUNDING.

SCIENCE APPLIED TO THE BRASS INDUSTRY*

ANDREW M. FAIRLIE

FOR the sake of progress in the brass industry, as well as for the advancement of science, it is highly desirable that the brass and scientific men learn to know each other better. Science is not nearly so formidable as many believe. She should be respected, it is true, but not treated with awe; for the benefits she has bestowed, she should be admired, not feared and shunned; and while she continues to promise aid, economically lightening the labors of men, improving the quality of products and the efficiency of processes, she should be cherished, not ignored, maligned not abused.

Science, it must be admitted, is a forbidding word. Yet it need not be. As indicated by its derivation, science is nothing more nor less terrible than knowledge. More specifically, it is the knowledge of nature's laws. An incident that occurred in the course of this day's work will illustrate at once the meaning of science, and its value to the brass industry. Mr. X. was superintending the manufacture of a new metal, an alloy of nickel and lead. He weighed the metals himself, and was particular that the percentages should remain exactly as planned. He was out of the foundry when the lead was added, but stepped in just as the men were skimming, and as he did so, saw a heavy lump fall from the crucible to the floor.

"What's that?" asked X, suspiciously.

"Slag from the coke," was the reply, and this statement was corroborated by a fellow workman.

Not content, X plunged the lump into water to cool it, scratched the surface with a file, and saw that the lump was not slag, but metal. Application of the magnet indicated that the metal was either nickel or iron, and a simple chemical test excluded the latter, so that the deduction was plain. The men chilled the nickel by adding the lead too fast, then skimmed off the frozen nickel, which had come to the surface of the lead, and so, entirely ignorant of this fact, spoiled their work. In this case only very elementary science, or knowledge, if you will, was required to detect the error and apply the remedy—a new casting.

Contemplating the help that science has already given the brass maker, analytical chemistry at once claims our attention. This branch of chemistry detects injurious impurities in the commercial metals from which brass is made; it locates and measures the losses in the business; by pointing out the sources of inaccuracy, it standardizes the mixtures of a casting shop; it shows the exact composition of any metal submitted for reproduction; by selecting the good and bad qualities of molding sands it improves the quality of sand castings; it distinguishes good coal and coke from poor, and in many ways discovers the cause of trouble.

Metallurgy, in its turn, has been of service. The methods of recovering metal from scrap have been improved. The cause of porosity in castings has been found, and the soundest castings

*Presented at the Philadelphia convention of the American Foundrymen's Association.

are now possible by the use of deoxidizers, such as silicon, phosphorus, aluminum or magnesium. The oxidation of metals in the foundry has been diminished by keeping the molten metal surrounded as much as possible by reducing gases, both while melting and while pouring. The pernicious effect of the iron stirrer for mixing alloys has been demonstrated, and one of graphite substituted.

Physics has furnished the conductivity bridge and the pyrometer. Since extremely small proportions of certain impurities in copper have a powerful effect in depressing the electrical conductivity, the former has been adopted as a quick and accurate means of testing the purity of refined copper. The pyrometer, by controlling the temperature, tends to render furnace processes more exact. The microscope, extending its researches to the examination of the non-ferrous metals, has been directed upon polished and etched sections, of copper, brass and bronze, and has revealed the varying structures resulting from different degrees of heat in melting and pouring, as well as from forging, rolling, and other mechanical processes.

In the electro-plating industry the value of circulating the electrolite, either by rotating an electrode or otherwise, has been recognized and the principle applied.

But it is not possible, nor, indeed, is it necessary, to enumerate within the limits of an association paper all of the scientific discoveries and inventions adopted in practice by the brass industry since the days when, eighty years ago, sheet brass was made in Waterbury, Conn., by alternately passing the ingot between heavy steel rolls and annealing in the flames of a chestnut wood fire. So much for the past and present—what is the outlook for the future? Completeness applied to the future is, of course, out of the question, and one must be content with a study of the signs of the times. Even thus the limitations of time and space serve an injunction against completeness, and we can consider here only a few of the problems which confront this generation.

We had in mind just now the electro-plating industry. The electro-plating shop needs the chemist and metallurgist more, perhaps, than any other branch of the non-ferrous metal industry. An examination of the inquiry columns of the trade papers demonstrates that rule-of-thumb methods in the plating room do not meet the requirements. The trouble experienced by the platers in controlling their solutions and costs and the quality of their work is simply evidence that the electro-plating shop ought to be, and must become an electro-chemical and metallurgical laboratory on a commercial scale; that the handful of this, the pinch of that, and the bucketful of the other—yes, even the dram and ounce and gallon—must give place to the gram and the liter; in short, that science must foster an industry that was born of science. It is too much to say that science is now prepared to solve off-hand any electro-plating problem that might be presented. Problems in practice require scientific investigation, and as electro-plating problems have been neglected, much painstaking work will be required for their solution. Let us see what probability of success is offered to stimulate efforts in this direction.

Ideally, the metal dissolved from an anode showed equal the metal deposited on the cathode, the bath remaining unchanged. Practically, this desideratum is today seldom achieved. Impurities in the anode dissolve in the bath, polluting it, and at the same time metal is deposited on the cathode more rapidly than it is dissolved from the anode. The excess is derived from the bath, with consequent variation in composition. Furthermore, certain impurities, insoluble in the electrolyte, either form a coating on the anode, partially insulating it, or, falling off, foul the bath; consequently the electrolyte has to be regenerated or renewed from time to time. Such obstacles should not be regarded as insurmountable. On the contrary, experience shows that

patient application of scientific principles will overcome such difficulties. For example, several years ago Dr. N. S. Keith was confronted with a problem in the electrolytic refining of lead base bullion.* His solution of lead acetate and lead nitrate became decomposed, with the formation of insoluble salts which interfered with the deposition. The problem was finally solved by substituting for the original bath an electrolyte composed of lead sulphate dissolved in sodic acetate. Dr. Keith avers that the integrity of this electrolyte was preserved indefinitely, that the salts give no further trouble, and that equal amounts of lead were deposited at the cathode and dissolved from the anode. The extension of such studies as this to electro-plating is what the industry needs.

Prof. Burgess has described a process for the electrolytic stripping of brass from iron,† by means of which superfluous brass may be stripped from parts of bicycles, and automobiles, and other work which has been subjected to the brazing process. Silver can in the same way be recovered from old articles submitted for replating, and from suspension rods, hooks and baskets used in the process. Files clogged with brass, copper or lead may be cleaned by this means, and the coating of tin or tinned iron may be recovered. It remains for science to invent, and for the electro-plating industry to apply, a satisfactory electrolytic process for stripping nickel from iron. It is a significant fact those metals most amenable to the electro-plating process are metals which alloy readily and which are easily soldered together.

Hence the theory that both electro-plating and soldering depend upon the uniting of two metals on surface alloying at the point of contact. A new process of coating metals, viz., sherardizing (so called after its inventor, Sherard Cowper-Coles), has demonstrated, according to Alfred Sang,‡ that surface alloying is possible, and that, too, at comparatively low temperatures. Briefly, sherardizing consists in coating the surface of metals with zinc by means of zinc-dust, or "blue powder," a by-product of the zinc smelters.

Mr. Sang describes the process as follows: "The articles to be coated are placed in a cast iron drum and covered with commercial zinc-dust; the drum is closed tightly, and placed in an oven heated to a temperature of about 300 degrees Cent. The length of time during which the articles are exposed to the heat depends on the thickness of the deposit desired. At the end of the heating period the drum is allowed to cool, and the articles are taken out. Notwithstanding the fact that metallic zinc does not vaporize below 940 degrees Cent., the zinc-dust is found to vaporize at the low temperature mentioned, and, being at a higher pressure than the atmosphere of the oven, the zinc gas penetrates the metal to be coated, forming on iron articles a protective surface said to be superior to either hot or cold galvanizing."

Commenting on the characteristics of the coating, Mr. Sang says:

"There is no doubt about the combination of the zinc and the metal of the article being sufficiently intimate to be classed as an alloy. Copper which has been Sherardized shows a skin of hard brass, and the blow-pipe is unable to form a bead of zinc on the surface of Sherardized iron as it does when the iron has been hot or electrically coated. The longer the process is conducted the deeper will the vapor go into the metal."

It may be that enthusiasm for the new process has banished for a time the sober judgment of its investigators; but if even half of its claims can be justified, Sherardizing has before it a field for operation unlimited in extent. If the process is commercially practicable, to what lengths will it eventually go? Successful in producing surface alloys at a low temperature, it is possible that our scien-

Electrical Industry, June, 1903, p. 345.
†Chas. F. Burgess, "Electrolytic Stripping of Metals," *Electro-Chemical Industry*, January, 1904, p. 8.
‡"Theory and Practice of Sherardizing," *Electro-Chemical and Metallurgical Industry*, May, 1907, p. 187.

tists may yet develop an economical process for the cold manufacture of brass.

Other problems of the foundry, more practical ones, and of greater interest to the manufacturer and the business man offer opportunities for the advancement of science and the progress of the metal industry. What, for example, do the brass melters know of the efficiency of their furnaces—that is, of the relations which the heat units utilized bear to the heat units contained in the fuel consumed? Are they aware that, given the proper data, such relations can be calculated, and that the information so obtained can be used as a basis for devising new and more efficient furnaces?

The value of science to our industry has been merely hinted at; any one of the topics suggested could be enlarged upon so as to exceed this paper in volume, and more topics could be added. But these hints may suffice to win new advocates for science applied to the brass industry.

New advocates for science among the brass manufacturers—greater intimacy between science and art—is the first requirement for progress. Other conditions, already laid down* for the progress of another industry, yet applicable to our own, are: 1—Wider circulation of scientific and technical literature; 2—discovery of new facts in science useful to the industry; 3—clearer knowledge of the laws correlating these facts; 4—increasing application of science to industrial needs.

SOME PECULIARITIES OF ALLOYS

C. VICKERS

The experimenter who seeks to form new and useful alloys, by a combination of widely differing metals, occasionally encounters very interesting phenomena, some of which are not altogether unattended with danger. An incident which happened to the writer some time ago will illustrate this point. The object sought in these experiments was to find an alloy of iron with bronze, which, would give a casting, with a bronze exterior and an iron interior, in other words a casting of iron possessing a bronze veneer.

This is not such an impossible thing as might appear on the face of it, for the writer met with sufficient success to convince him that the thing is quite practical, and that it is possible to make such castings. In the course of the experiments some cast iron was melted in a crucible and alloyed with aluminum. The molten metal lay quiet in the crucible and it was considered desirable to add a certain percentage of zinc, in order to determine what effect this metal would have on the iron aluminum alloy. Anticipating a violent reaction the zinc was broken into small pieces, to be added as gradually as possible, and, about two ounces were lightly tossed into the crucible onto the molten iron.

For a few seconds all was quiet, when, as the operator was about to introduce a thin iron bar to stir the mixture, a muffled explosion was heard, succeeded by others in rapid succession, accompanied by a violent eruption which shot up towards the roof of the shop, giving a beautiful Fourth of July display of shooting stars and blue lights, the first being produced by the iron, the dazzling blue lights by the zinc, with flakes of molten metal in between, which made some lively dodging necessary before the eruption could be corralled, by the heavy iron cover of the furnace.

The display continued until the crucible was entirely emptied, when it ceased, and the pot was apparently empty, the introduction of the iron bar was the signal for a re-opening of hostilities on a somewhat diminished scale. Fortunately there were only a few pounds of metal in the crucible.

* By Prof. J. W. Richards.

BRASS FOUNDRY NOTES

C. VICKERS

Question:—Am having considerable trouble owing to the variation of the metal as it is cast from day to day. My mixture contains one of tin to seven of copper, and it is varied according to the use for which the brass is intended. I use an oil furnace and also use Texas oil with metallic phosphoro and salt for a flux. Some days the work is practically perfect, and on others the metal has almost a copper color after it is cast and is full of blow holes and cannot be machined. We keep the metal very hot while pouring and the surface of the mold is constantly kept clean, but when the brass is machined it shows up the holes. When made in crucibles, same mixtures are all right. Can you give me a suggestion as to how to overcome this trouble?

Answer:—To quote from the letter "Some days it (the metal) is practically perfect," therefore sometimes the furnace is properly managed, and under such conditions it performs good work. Clearly then, on these successful days is the time to study the conditions under which the furnace was operated to determine the things essential to a successful melt. It is likewise as necessary to make a study of the evil days, for we can learn more sometimes, from our failures than from our successes to discover what has been done on the bad days that should have been left undone, and what has been left undone, that should have been done.

Study the workings of your furnace, study it carefully. You have something to guide you to a solution of the puzzles as on some days the furnace works properly. It will work properly every day, if properly operated. How to do that you must find out for yourself. It is an easy matter to do so, and when you have succeeded, you will be far better informed than if somebody had merely advised you.

It makes no difference what kind of a copper alloy you are making, where the oil you melt with comes from or what you use for a flux if you overheat the metal, and keep it overheated you are simply storing up trouble.

"Some days the metal has a copper color." Just think what that means. A "seven to one" alloy is anything but copper colored. Where, therefore has the tin gone? It must have been burned out, and in accomplishing this the entire heat of metal has been ruined. You have consumed time, labor and fuel to simply change back your metal to a state of nature. No wonder it is "full of blowholes and cannot be machined."

Again, the metal is poured "very hot," which is exceedingly bad practice, excusable only in the case of very thin castings which would not run otherwise. For this class of work a crucible is better than an oil furnace, and I would advise their use in all such cases, as the metal can be better protected from oxidation, while being superheated to the proper temperature for pouring. With castings that are a quarter of an inch or more in thickness, pour cooler and you will have better success. If the castings are heavy pour as cool as possible, a few trials will determine this point.

I repeat, study your oil furnace, learn to run it intelligently, remembering that although you may be able to bring the inside to a white heat, such a temperature is unnecessary in melting copper, is in fact exceedingly injurious to the metal. And until you learn how to handle it, take more time to get out the heats, by keeping down, the temperature of the furnace.

OXIDIZED METAL.

Question:—We are having trouble at the present time with our brass castings, inasmuch as they show fine pin holes. Our principal work consists of the manu-

facture of journal brasses and bushings. The bushings weigh from 10 pounds to 350 pounds each, but we fail to get them solid. When the surface is turned off we find that the little holes appear in varying numbers. We use considerable scrap brass, as much as we think the castings will carry. We have tried making these castings by using a certain percentage of scrap brass and a certain percentage of copper, with phosphor tin and without phosphor tin, that is, just the ordinary tin. The castings look nice on the outside, but when they are turned they show little blow-holes. We would like to know if silicon copper would remedy this, and how much to use, and what form it comes in.

Answer:—Your trouble is caused by "burnt" or oxidized metal, and is caused by improper handling in the furnace. Experience has taught me that the melting of copper and its alloys is the most delicate operation in founding work; an operation that is so imperfectly understood that many brass melters obstinately refuse to believe there is such a thing as "burnt" metal, and that it has any connection with spongy castings.

In taking on this subject with a veteran melter the other day, I was hotly assured that "burnt" metal was all bosh; there was no such thing. This particular melter said he had melted brass for 20 years, and it was no use talking to him about "burnt" metal; he knew better than that. It was the molder, not the melter, who was to blame, as no two molders worked alike, one had his sand wet, another dry, another rammed soft, another hard, and so on, *ad nauseum*.

And this is the ignorance that the foundryman has to deal with, the ignorance that knows it all, and yet knows so little, the most dangerous kind of ignorance possible to encounter; and this is why the spongy brass casting, like the poor, is always with us.

The melting of brass requires constant and unremitting vigilance, on the part of the melter, as the metal while heated must be protected from air exposure as much as possible, as it has such an affinity for oxygen (a gas, as everybody should know), which combines with the metal forming oxides, dirt, dross, burnt metal, or whatever you like to call it, and which is responsible for the holes we find under the skin of brass castings.

The melted brass should be kept covered at all times with charcoal, melted glass, or any suitable flux. Solid metal, as it is added from time to time, should be pushed down into the melted mass, as soon as it is heated, and the operation becomes possible. All of this requires extra exertion on the part of the furnace man, and it is very hard, hot work, so it is a conscientious man indeed, who does it faithfully.

Contrast the melting of other metals with brass, the behavior of lead is quite different; we can pile the crucible up and as it begins to melt, little drops ooze out; these trickle down to the bottom of the crucible, and presently the whole mass sinks into perfect fluidity of its own accord, needing no external aid whatever.

Cast iron will also sink down into a crucible as it melts; the crucible is filled and piled high, with pieces of pig iron buried in coke, and in due time the pot is filled with hot fluid metal, which makes perfect castings.

Copper and bronze under similar circumstances do not sink down of their own accord, but must be pushed down because at a certain stage of melting, they become pasty and in this condition adhere to particles of fuel, the walls of the crucible, to other pieces of metal, etc., and sink down to fluidity so reluctantly, that on arriving there, they lay on top in a wilted condition, which is highly oxidized, therefore as soon as brass becomes heated, it must be pushed into the metal below to protect it from oxidization as much as possible.

I have written on the subject of careless melting several times before, and have hammered at it again, because I know that it is the most important part of brass founding. To treat the subject fully would require a volume, so there are many things I have necessarily left unsaid, but I wish to impress on this correspondent, the necessity for reform in his melting arrangements.

The castings he speaks of should be

easily made from scrap entirely, and come perfectly solid, without the addition of phosphor tin or anything else. In my present practice, I never use any other than scrap metals, with the best of results.

Silicon will be of no value in this case, as it will only change the pin-holes into dross. I advise against its unskilled use. In the near future I hope to treat of the action of silicon on brass and bronze alloys—in the Brass Foundry Notes.

Silicon comes in the form of silicon-copper, containing 30 per cent silicon and 70 per cent of copper. It can be obtained from the Primos Chemical Co., Primos, Pa., at a present cost of 75 cents per pound in small quantities, f. o. b. Primos.

BRONZES THAT WILL RESIST PRESSURE OF BALL BEARINGS.

Question:—I would like to have a formula for a brass or bronze that will be very hard and will resist the pressure of ball bearings, and yet can be drilled and tapped.

Answer:—The following alloys should afford a selection:

1. Copper, four pounds, tin, one pound.
2. Copper, five pounds, tin, one pound.
3. Copper, six pounds, tin, one pound.

To each of the above alloys add one per cent each of zinc and lead.

TENSILE STRENGTH OF ALUMINUM CASTINGS.

Question:—Can you give me information as to the method of increasing the tensile strength of aluminum castings?

Answer:—To increase the tensile strength of aluminum castings, aluminum is generally alloyed with from 5 to 7 per cent of copper. One 7 per cent alloy recently experimented with showed a tensile strength of 27,000 pounds per square inch. Pure aluminum on the other hand, has a tensile strength of only 12,000 pounds. Where the tensile strength is high, however, the elongation is low, and where the tensile strength is low the elongation is high.

ALUMINUM IN CAST IRON.

Question:—I have had considerable trouble with blow-holes. I used aluminum as you advised, and the blow-holes nearly disappeared, but I find on the top side of the castings a scum which on being scraped, breaks away but leaves a very bad surface.

Answer:—Use pure aluminum and do not use enough to form the scum. Casting aluminum sold for making castings will not answer.

THE ART OF GALVANIZING*

ALFRED SANG

(Concluded.)

I MUST tell you more about zinc vapor. This vapor is a gas just like air or any other gas and subject to the same physical laws, but as it is produced by the breakdown of zinc-dust particles at a very moderate temperature, it finds itself in the gaseous state at a point below its critical temperature and it will therefore readily assume the solid state by condensation under its own pressure, confined as it is within a retort.

When iron is pickled, hydrogen is given off on the surface and rises to the top of the vat. The pickle works its way into the metal and hydrogen

*Presented at the Philadelphia convention of the American Foundrymen's Association.

is given off below the surface and remains occluded. This occlusion has very surprising results; the surface of the iron is hardened and if it is to be drawn through a die or worked in any way, it is necessary to bake out the gas. Hydrogen has been long suspected of metallic proclivities; it is often classed as a metal. It is known to form an alloy with palladium and it is supposed to alloy itself to the iron to produce the hard skin of which I have spoken. Zinc vapor acts in the same way in Sherardizing, but it forms an alloy all the more readily because in its normal condition it is itself a metal as we generally understand that rather arbitrary term.

Being a gas, the zinc vapor can force itself into the pores of the metal and form a deposit to a depth which will increase with the duration of the treatment. A small piece can be alloyed throughout. An alloy of zinc and iron produced by fusion would be a sorry article when it came to be tested; "zinc-eisen," as it is called, is zinc ruined by the addition of a quantity of iron, which renders it brittle and worthless. By alloying with vapor at a low temperature the qualities of the metal cannot be injured, but they may be greatly improved by the zinc forming an intermolecular binding, which fills spaces which would otherwise allow motions of the particles under stress which might injure their cohesion; the vapor deposit should increase toughness and it is quite possible that this theory may have some bearing upon the general subject of the nature of alloys.

By using carbon as a condenser for free zinc vapor, out of contact with the dust, I have obtained a perfect zinc dew. I used a common arc lamp carbon and the drops on the top were large and reduced in size down to microscopical proportions on the edges. Here and there on the inside were traces of zinc, showing that the gas had penetrated the mass. The zinc vapor had not alloyed to the carbon, the specific heats being wide apart, whereas I have observed that the closer the specific heats of the zinc and the material to be coated at their working temperatures, the more quickly and firmly would they combine. It is no doubt on this account that copper Sherardizes so much more rapidly than does iron.

Improvements in Sherardizing will undoubtedly be founded on the intelligent control of the temperature, but to this end temperature readings will have to be taken inside the retort and not in the furnace as heretofore.

Working with gas alone and under the special conditions necessitated by the peculiar circumstances of the experiments, I was able to obtain quite a variety of deposits. Rapid cooling will cause the zinc to condense as crystals the adherence of which to the iron is, however, inversely proportional to their size. Normal cooling would seem to yield in all cases a fine glossy surface of what can be appropriately termed ferro-zinc.

Examining this ferro-zinc under about 400 diameters of enlargement it exhibits the structure of the original metal. A piece of mild steel which had been thoroughly pickled and which had been treated by vapor only, and was, therefore, free from any exterior zinc coating, such as would have concealed the alloy if operated on in contact with the dust, exhibited the usual structure of an etched mild steel. This ferro-zinc appears to be harder than the original iron and its rust-proof qualities are the true secret of the exceptional efficiency of Sherardizing.

The Creece test with sulphate of copper is not a fair test for Sherardizing, it is almost without significance for the following reasons: The outer coating of the slightly oxidized zinc particles resists the text better than does the brighter hot coating or the porous electrolytic one, but the alloy, obtained by vapor treatment alone, and which is present in all Sherardizing, readily takes the copper just as the iron itself would, and yet it will resist corrosion perfectly. The copper will deposit without destroying the

zinc and the test is, therefore, worthless. The only way to test Sherardizing is to put it into service.

The alloy known as nickel steel does not rust easily and yet in a nickel plated article if the nickeling is partly removed the iron will be corroded. This shows that we must not expect contact theories to adapt themselves to perfection to metals in solution, and to alloys. The alloy of nickel and iron resists corrosion and in my opinion it is a parallel case to that of ferro-zinc.

The Romans to make their brass, which they called "Orichalcum," threw cadmia, (oxide of zinc) on highly heated copper. The more recent calamine brass process which was in use until about one hundred years ago, consisted in heating calamine (zinc silicate), granulated copper and coke—dust in crucibles, the fusion and alloying taking place at a temperature considerably lower than the melting point of copper. I thought these two points of history might interest you by comparison and as aids to the digestion of the most recent developments.

The Theory of Dry Galvanizing.

Let us enter the Sherardizing retort and endeavor to find out what takes place. Which guess will offer the most plausible explanation? It is an established fact that in Sherardizing the presence of zinc oxide is necessary. We might suppose, therefore, that a molecule of oxide is reduced by voltaic action when it comes into contact with the iron; the zinc attaches itself to the iron which acts therefore, as a cathode in electrolysis, and the oxygen travels in the opposite direction, combines with a free molecule of zinc to form a molecule of oxide, and goes through the same performance as before.

I have excellent reasons, which I must keep for later publication, for believing that this hypothesis is pretty close to the truth if not the true explanation of the action in dry galvanizing.

The outer coating is composed of reduced zinc in granular form and the silver gray appearance may be due to slight oxidation of the surface.

Whatever the true explanation may be it is of little immediate interest to "practical" men, but it is of great interest to scientists who are expected to continue furnishing their abstract facts to serve as souls to the concrete bodies created by inventors. The inventors, while claiming all the credit, usually sell or lose most of it to men who put these inventions into practical use. He laughs best who laughs last, and by the time the invention has become an industry the poor scientist has been entirely forgotten,—except to be occasionally dubbed a theorician, a dreamer, a simple soul, a mild and childlike,—for of such is the kingdom of heaven.

The Efficiency of Dry Galvanizing.

The efficiency of dry galvanizing, which has been proved by thorough testing both in England and Germany, is due to its fulfilling the conditions which I have set forth in the early part of this paper.

Considered merely as a covering, it fits as closely as does an electrically deposited coating and it is impenetrable because free from pores or cracks.

As a mechanical protection it resists both abrasion and impact better than hot or cold work because of the qualities of the ferro-zinc alloy. Zinc itself is superior to both tin and lead in ductility and tenacity.

Considered in relation to contact effects the zinc distilled as vapor and alloyed to the iron is absolutely pure and the span between it and the iron in the electromotive series is, therefore, extended as compared with a zinc containing a percentage of impurities. Its contact with the iron in the body of the alloy is as perfect as is possible. In relation to corroding agents its granular structure offers a maximum surface for them to decompose and, therefore, increases the ratio in which the coating acts by its own decomposition as a protection to the iron.

Commercial Scope of Dry Galvanizing.

It is a noteworthy fact that while many articles have appeared in techni-

cal and scientific journals about Sherardizing, not one word of criticism or denial of its claims has as yet been offered. I have been looking for serious criticism for some time past but when I have found doubters I have only succeeded in making new converts. The process has always appealed to scientific men because they are in position to appreciate the solid scientific foundations of its claims.

The new process has not entered the field as a competitor to galvanizing alone; in a great many instances it can take the place of coppering, of nickel-plating and of tinning, where the articles are not to be used for the preparation or handling of foodstuffs. To these I should add the large amount of copper and brass articles, from tubing to typewriter and sewing machine parts which are now nickel-plated. An interesting point in relation to the various methods of protecting metals is the price of the metals themselves. Nickel is 7¾ times, tin and aluminum 7 times, copper 4⅛ times and antimony 3¼ times as high in price as spelter, and at equal efficiency against corrosion the lightest coating is one of zinc as applied by dry-galvanizing.

Analyzing the various items which go to make up the cost of Sherardizing, we find that in every instance there is a saving either over the hot process or over the electric process. In most cases the saving is over both of the older processes.

Initial Expense.

A plant for Sherardizing is less expensive than a hot plant and very much less so than an electric plant. Every part of it is of a simple nature and calls for neither feat of engineering nor for the solution of any out-of-the-way problems. It is very much like a plant for close annealing, and whereas the depreciation on a hot plant is usually taken at 50 per cent per annum, the depreciation on a Sherardizing plant would not exceed 10 per cent. which is the depreciation commonly figured on an electrolytic plant. The drums are not made of perishable hard rubber or wood as are those for electrolytic galvanizing. The process can be carried on in the main manufacturing building, and the pickling done in the cheapest kind of an outhouse.

The Saving in Cost of Zinc.

For an equal thickness of coating, the zinc actually deposited is about the same in value whether derived from dust or from spelter slabs. It is less than the anodes used in electrolytic work which have to be cast specially and are very often of odd or complicated form. Even less zinc is required than in the electric process because an equal thickness is more effective and because the distribution is fully as even. In Sheradizing there is nothing to throw away, but sufficient dust (from 1 to 5 per cent) is added from time to time to replace that of the weight of the articles coated which has been used. There is no equivalent to the unsatisfactory results due to using spelter recovered from dross and therefore contaminated by the presence of iron.

In electro-deposition an unobstructed path is required between the anode and the object, for the dissociated ions of the salts in solution to travel. If any part is hidden or recessed no deposit is made and the parts furthest from the anodes have the lightest coating. In addition to this it must be understood that the anodes are not entirely used up and part of them is lost at the bottom of the tank, and as eaten-out remnants they cannot be used to the vanishing point.

It is hardly necessary to point out the enormous saving in the quantity of zinc used as compared with the hot process. Hot galvanized articles have, as a rule, a much thicker coating than is necessary because most of them cannot be conveniently wiped like wire or band iron. In Sherardizing all the zinc is consumed and the thickness of deposit is regulated just as readily as in the electric process. In the hot process a large percentage of spelter is converted into dross and skimmings, and while much of it is re-

covered, the net loss cuts quite a figure on the cost sheet.

The Saving in Labor.

Sherardizing is like annealing in that it requires but a small amount of labor, and that unskilled, placed under proper superintendence. A drum holding one or more tons of articles can be left to itself for half an hour or more subject to an occasional turn; in the meantime another drum is being prepared for Sherardizing while the first will be cooling. Suitable partitions will allow of several classes of small articles being Sherardized in one drum without mixing.

Hot galvanizing requires constant attention and handling, which can seldom be done by one man even with the aid of overhead trolleys and similar fixtures. It is not a mechanical or automatic process, but one of hard manual labor, and the regulation of temperature and methods of dipping require the attention of an experienced galvanizer.

As a leading authority on hot work has written: "Considerable skill is required to bring a piece of work out of the metal and cool it so that the surface will be smooth, free from blisters and with no lumps of surplus metal attached."

For the electric process at least one man possessing some knowledge of electricity and of all the whims of electrolytics is needed. In electrodeposition irregular shapes—excepting in the case of very small articles—require regular shaped anodes, but in Sherardizing the dust, every particle of which may be considered as a minute anode in itself, is used just as it comes from the refiners for any size or shape of article.

By combining the advantages of both the old processes, Sherardizing enables a manufacturer to galvanize with one plant only, articles which have hitherto been divided between the two processes, the small ones being electro-galvanized and the large ones dipped. Less care is needed in cleaning the articles to be Sherardized, and oil or grease, far from being objectionable, are helpful to the process, because their volatile hydrocarbons help to prevent oxidation of the dust; the addition of grease or vaseline has indeed been found to be of some advantage in many cases. Furthermore, the articles can be put into the drums wet, as they come from the washing tank. The labor of recutting threads is eliminated. Bolts, screws and nuts can be put in the drum just as they are delivered from the machines, covered with oil or cutting compound.

With small installations the process can be worked intermittently. The low cost of the plant warrants a manufacturer in running a drum two or three days a week instead of sending his work out, thereby saving time, freight and jobbers' profits. The temperature required is so low that it takes very little time to start the furnace and where gas is used this element of time may be almost disregarded. This low temperature also suggests using the waste gases of annealing and other furnaces, and in many cases it will be found economical to place a whole day's production in the retort and leave it in overnight with the night watchman to keep his eye on the pyrometer. There is no labor for skimming and drossing; no pots to scrape at unexpected times, nor furnaces to destroy and rebuild at all too frequent intervals.

The Saving in Fuel and Power.

The plainest fact about hot galvanizing is its thermal inefficiency. The pot must be kept going day and night, whether in use or not, and even during its operation most of the heat is lost by radiation and by having to bring the articles to the temperature of the bath. On the other hand, power is seldom an item of any consequence, whereas in electrolytic work the amount of current consumed is quite large, for a deposit which is meant for something more than exhibition purposes or to be buried out of sight and forgotten. This is seldom appreciated because electricity is unobtrusive in its action; the cost of electro-galvanizing thin sheets is prohibitive on ac-

count of the amount of current consumed. In Sherardizing the heat is very low and is kept in by a lining of refractory material; the articles do not have to reach the temperature of the zinc dust and the apparatus is always ready for work on short notice. The temperature does not have to be varied to suit the different sizes and classes of articles to be coated and as I have suggested, waste gases can be used under many circumstances.

Other Factors of Economy.

With the new process, less acid is used than in the electrolytic process because the cleaning does not have to be so thorough. The vapor works its way under specks of dirt and bare spots cannot exist. No flux of any kind is needed as in hot galvanizing, and there are no comparatively high-priced electrical supplies to be bought.

There is no danger whatever from explosions, no broken castings nor distorted iron work to replace, and the temper of the finest steel blades and of steel springs is in no way injured by the low temperature used. This may at first seem strange and will not be perfectly clear until we know something more about the temperatures existing and the reactions taking place in the retort.

Various Applications of Dry Galvanizing.

Sherardizing will not full an uncalked seam and act as a solder, this is its one limitation but it has a great variety of new applications to make up for it. Fly screening can be galvanized and the business parts of agricultural implements such as mower and harrow teeth can receive adequate protection at a low cost without impairing their qualities.

Flashing a surface electrically to discover flaws has been in use for some years and Sherardizing will render the same service; it is, in fact, being used at the present time for this very purpose for boiler tubes. However, while electric flashing is worthless against corrosion, a flashing with zinc dust or vapor is very effective as a rust preventive, and of particular service for articles which are to be shipped across the ocean.

Within reasonable limits innumerable machined articles, tools, locomotive and engine parts can be flashed with zinc and be effectively protected against rust under the conditions of their operation, whereas at present they must be periodically cleaned at the expense of their appearance and of the accuracy of their fit. Articles such as wire, tubes, etc., either flashed or coated with a heavy deposit can be drawn out, the coating drawing out with the material itself.

A brilliant and permanent polish which can hardly be distinguished from nickel-plating, but bluer and more like silver, and a better reflector of light, can be given to Sherardized articles by means of the usual burnishing tools and machines, but unlike nickel-plating it is absolutely rust-proof. This polish is not temporary like that of electro-galvanizing, and it is hard and durable if worked down, as it should be, to the ferro-zinc. The reason that it does not whiten by corrosion, as might naturally be expected, is because the surface has flowed to an impervious film and the iron is shielded from any contact effects. In this connection it should be remembered that highly polished steel is relatively rust-proof. If, however, nickel-plating is preferred a light Sherardizing before plating, instead of coppering, will ensure very thorough adherence of the nickel to the ferro-zinc and superior rust-proof qualities will be obtained. It has been shown that it is very difficult to volatilize zinc from alloys where there is any nickel present.*

Sherardized aluminum can be electro-plated and the objectionable soft surface be overcome, not to mention the finish and appearance.

Sherardizing has been found to protect silver from sulphated hydrogen which blackens it; it can be applied very lightly before polishing without altering the color. When aluminum has been Sherardized it can be readily soldered; this is expected to do away with the very unsatisfactory riveting

*See A. R. Haslam in *Chem. News*, Vol. 51.

of articles made from aluminum sheets. The latest application is for inlaying or damascening and this art is being carried out in England on a commercial scale. A variety of colors can be obtained by using different dusts and by varying the time, thereby obtaining alloys of different tints. The designs shade off in a pleasing manner beyond the edges of the stopping-off material which acts as a stencil in setting graphical limits to the action of the dusts and vapors.

It is very seldom that in the history of invention we find an improved process which corrects so many defects, removes so many limitations of the processes in use and creates so many new and novel applications as does dry-galvanizing.

OBITUARY.

Edward Maher, of the firm of Maher & Flockhart, Newark, N. J., and one of the best known foundrymen of the east, died at his home in Newark, June 15, of septic poisoning. He had been ill for only about ten days. Mr. Maher was born in Ireland, Aug. 10, 1852, and was brought to America by his parents two years later. While still a young man he learned the iron molding trade and eventually started in business for himself in Newark, though in such a modest way that, it is told, he himself delivered his castings about the city in a wheelbarrow. In 1882 he became a partner in the firm of Maher, Robinson & Flockhart, this name later being changed to Maher & Flockhart. The business prospered and has become one of the most important of its kind in New Jersey. Mr. Maher was one of the twelve men present at the meeting in New York when the National Founders' Association was formed. In this organization, as well as in the American Foundrymen's Association, he was always prominent, being a regular attendant at all conventions. He was repeatedly honored by his fellow citizens by election to positions of trust, serving four consecutive terms as a member of the Newark board of education and resigning in 1888 to accept the appointment of police commissioner, in which capacity he was chosen president of the board. He was also a member of the state board of education, vice president of the Newark board of trade and a generous supporter of numerous religious and charitable organizations with which he was closely identified. He is survived by a widow and three children.

EDWARD MAHER

William F. Jarvis, Detroit, died June 27, from appendicitis, aged 47 years. He was born at Palmyra, N. Y., and completed his education at Yale university. He engaged in business in Detroit in 1878 and afterward became the resident partner of the pig iron firm of Charles Himrod & Co., Chicago, whose Detroit business subsequently passed to William F. Jarvis & Co. He was one of the founders and the first treasurer of the American Radiator Co. He retired from active business in 1904.

John S. Wilbraham, secretary and treasurer of the Wilbraham - Green Blower Co., Philadelphia, died at Edinburg, Scotland, July 3. He was born in Philadelphia, Jan. 16, 1860, and was the son of Thos. Wilbraham, who founded the firm of Wilbraham Bros. in 1854. He became

and was the son of Thomas Wilbraham, who founded the firm of Wilbraham Bros. in 1854. He became connected with his father's business in early life, and was made secretary and treasurer of the company some 20 years ago. Mr. Wilbraham had been in ill health for several years, and sailed for Europe on June 15, hoping to regain his health. His death removes all but one of the Wilbraham family from the firm, as Thomas W. Green, chief engineer, is the only remaining member. Mr. Wilbraham is survived by his widow.

Augustus Trump, for some years secretary and treasurer of the Pittsburgh Steel Foundry, died suddenly at his home in the East End, Pittsburg, on June 11, of heart failure.

FOOT LEVER CORE.

C. B. DAYTON

In Figs. 1 and 2 are shown two ways of making a core, one of which caused considerable trouble, while the other proved a solution of the problem and resulted in castings that were perfect so far as their cores were concerned.

Before describing this simple method (I say simple, because to some readers it may look that way in fact, foolish) I may say that this bit of simplicity has resulted in a saving of at least 5 per cent of the entire output of this

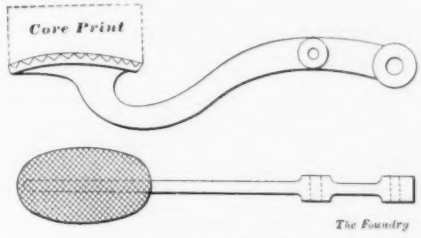


FIG. 1.—FOOT LEVER WITH DIAMOND CUT FACE

order. Fig. 1 shows a foot lever, the pad of which is cut on the face in diamond form. Various types and sizes of these levers have been made in the past and in each instance the print was made as shown in the dotted lines. There was nothing in the construction to prevent the core from shifting or falling into the mold, thereby producing bad or unsightly castings that were returned to the foundry to be remelted.

Fig. 2 shows a very simple change in the design of the core print, to which a core box was fitted, producing a core that was an exact fit in the mold. When the core was set and the mold closed the core could not shift or fall into the mold, owing to its dovetailed shape.

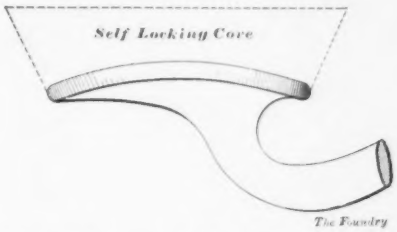


FIG. 2.—IMPROVED METHOD OF MAKING CORE

Another advantage was the ease with which the core left the box. The cost of making this print in this shape was no more than by the other method, yet the saving was considerable, both in the foundry and the core room.

PHOSPHOR COPPER.

Phosphor copper is an alloy of copper made by melting copper and phosphorus under suitable conditions. It is hard and brittle and has a white metallic fracture. It may be obtained up to about 16 per cent of phosphorus.

SILICON BRONZE.

Silicon bronze has great tenacity, resists atmospheric corrosion and at the same time is a much better conductor of electricity than phosphor bronze as the presence of a small quantity of phosphorus greatly diminishes the electric conductivity of the alloy. Wires of silicon bronze are therefore used for telephone and other purposes.

AUTOMOBILE ENGINE CYLINDERS.

In English foundries automobile engine cylinders are cast with the flange uppermost, and for this reason a head of metal is required, washing all dirt to the top of the mold. Care is taken to secure perfectly vented molds and cores.

THE TRAINING IN FOUNDRY WORK AT PRATT INSTITUTE*

Course of Instruction to Properly Prepare Students to Advance to Positions of Executive Responsibility

PROF. WM. C. STIMPSON

AT the present time, when there is so much being said in the daily papers and the current magazines about trade and elementary technical education, this Association may be interested in a short description of the instruction in foundry work given at Pratt Institute.

Before attempting to describe what we are doing I should like to point out a few things that we do not attempt, in order that there may be no possibility of misapprehension regarding what I shall say later. To start with, we are not a true trade school, and we do not attempt to turn out journeymen mechanics. We cannot graduate journeymen molders because the time devoted to foundry work is far too short, and the class of young men who mean to earn their living as practical mechanics in this trade could not make the sacrifice of either time or money that would be required to thoroughly master the trade in a school.

On the other hand, we are far removed from the engineering schools of college grade like Cornell or Columbia or the Massachusetts Institute of Technology. In some instances we may teach the same or similar subjects, but we approach them in a very different way, and the attitude of our students toward their work is also quite different.

I have pointed out these two things that we are not a trade school on one hand, and an engineering school on the other, because I believe it will help us to a clearer comprehension of the field we do cover, which lies almost exactly half way between these two. We aim to give at Pratt Institute courses of instruction which will properly prepare men to rise to positions of the grade of master mechanic, or foreman, or assistant superintendent, after they have had sufficient practical experience. For positions of this kind some theoretical training is necessary, but to make it effective it must be combined with a great deal of very practical training.

So far as our work turns in either direction, therefore, our methods, I believe, tend to approach more nearly those of the trade school than they do those of the engineering school; for, in the main, our men learn how to do things by actually doing them, and incidentally study the whys and the wherefores of the work as they go along; for we do not want them to do anything which they cannot do intelligently. It should be noted, however, that the emphasis is placed very largely on the quality of the actual, practical work.

Thus far we have not specialized at all along the different manufacturing trades such as pattern making, foundry work, machine forging or machine work. Our aim has been rather to turn out men who would be likely to go into manufacturing plants which include several, or perhaps all, of these branches. At the present time, therefore, we have no course designed espe-

*Presented at the Philadelphia convention of the American Foundrymen's Association.

cially for foundrymen in which the student can devote his entire time to this kind of work, but if it were plain that there were sufficient demand for such a course I am not at all sure that

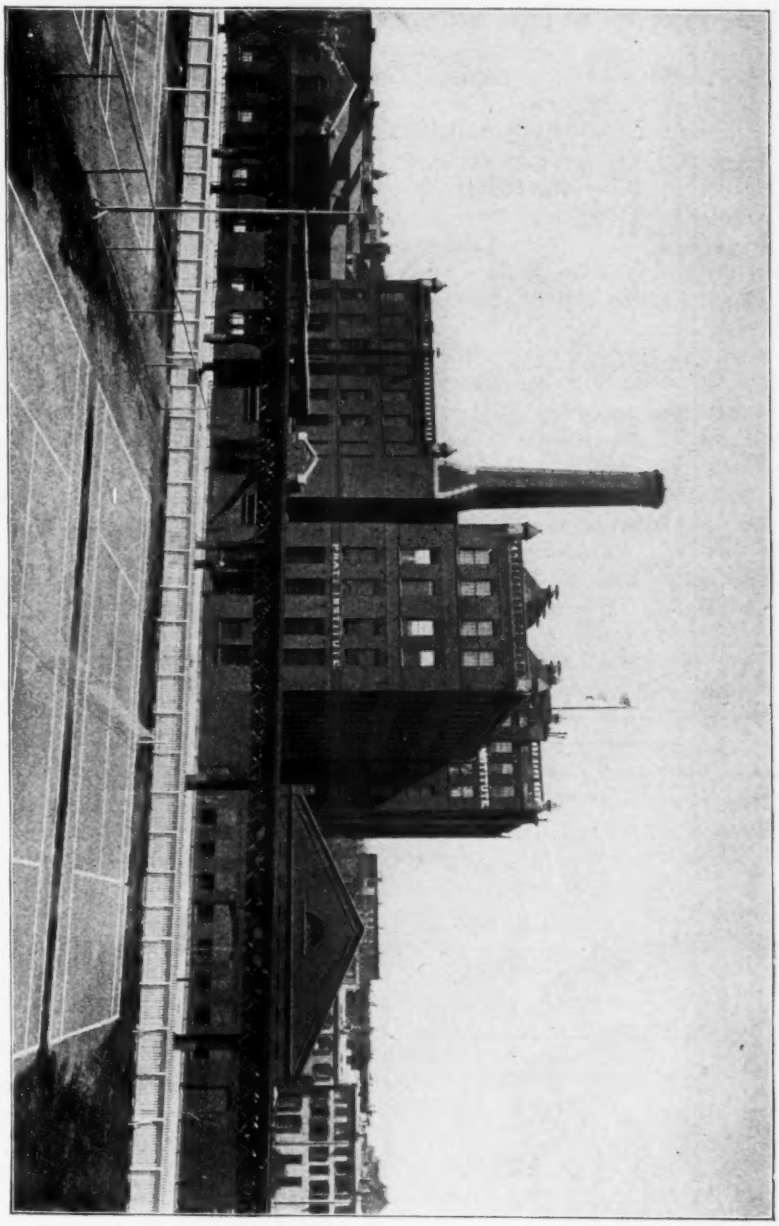


FIG. 1—SCIENCE AND TECHNOLOGY BUILDING

our trustees might not feel inclined to consider its establishment.

In most manufacturing establishments, however, the four main constructive departments referred to above are so closely related to one another as to require men who have some intelligent understanding of all these branches, and the purpose of our regular mechanical course has been to provide instruction for such men.

Departments.

In describing the aims of this course, into which the foundry work enters as a most important element, or in

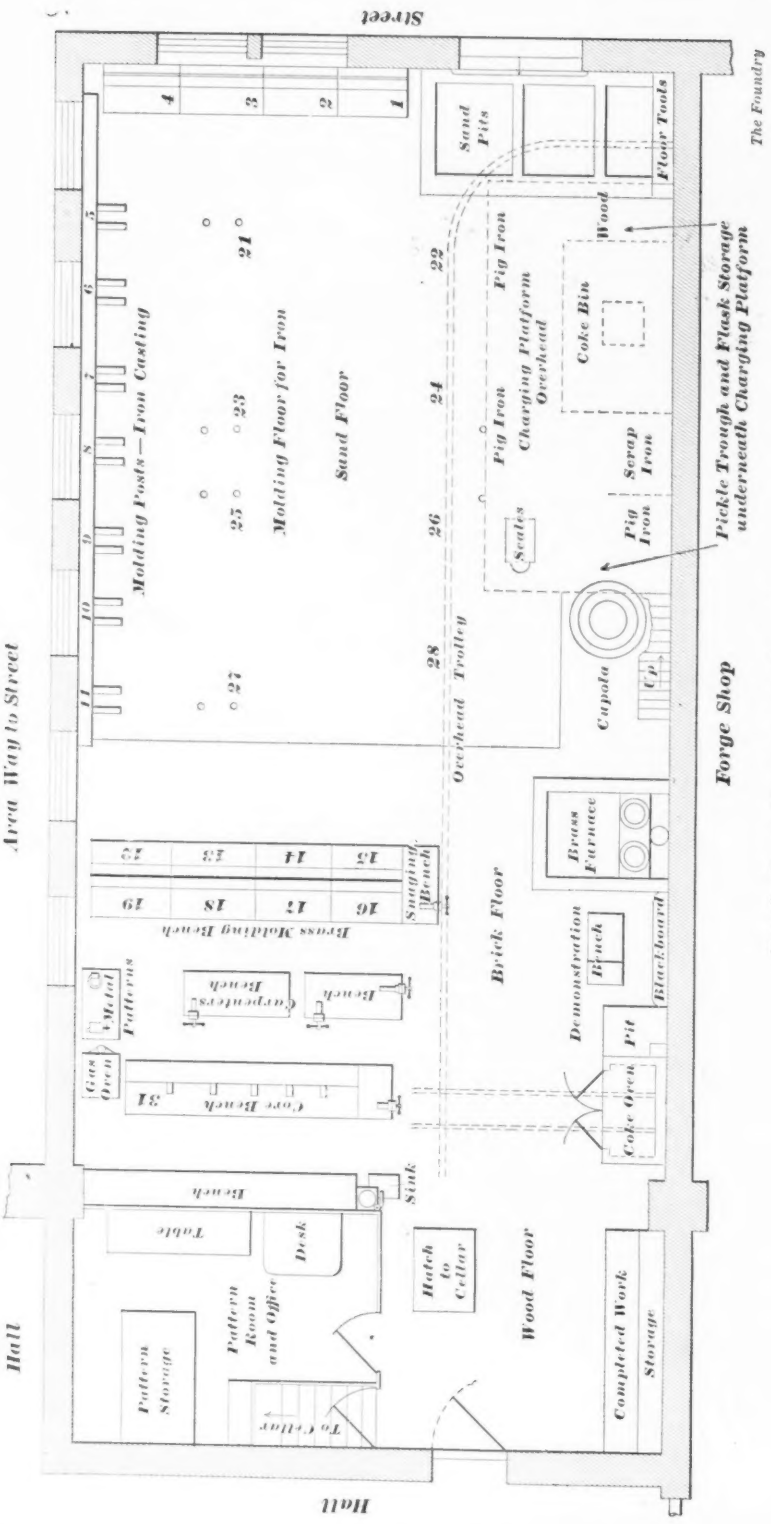


FIG. 2—PLAN VIEW OF THE FOUNDRY

giving the more detailed description of the foundry which will follow, I do not wish to give the impression that this is by any means the only course offered by Pratt Institute, for, as a matter of fact, there are now more than sixty other courses, many of them day courses and others evening courses, in all of which, taken together, there is an enrolment of between 3,600 and 3,700 students drawn from nearly every state in the Union and from a number of foreign countries. It requires nine different buildings to house these classes, but those in which we are principally interested are the chemistry building, the electrical building, and the so-called science and technology building, Fig. 1, which contains the department of physics and practical mechanics, mechanical drawing and machine design, and most of the shops. Grouped together in these three buildings is what is known as the Department of Science and Technology, and before discussing the details of the subject of this paper it may not be amiss to give a word or two of description of the department as a whole, and a list of the technical and trade courses which it offers, in order to give the members of the Association some idea of the setting which surrounds the foundry work at Pratt Institute.

The Department of Science and Technology.

Some idea of the importance of this type of education can be gathered from the fact that the Institute which Mr. Pratt founded only twenty years ago started with an enrolment of but twelve students and has grown to the proportions mentioned above; and during these twenty years has given instruction to more than sixty thousand individuals. Mr. Pratt, when he started the school, was guided and inspired very largely by his own experience. He was a self-made man, having started life as a machinist, but he was a man of unusual breadth and power. He wanted a school where young men, and young women, too, for that matter, who were situated as he had been could have the chance that he had missed. He knew what they needed; and he knew where the average school failed. He thus was able to plan with an insight and a foresight which has everywhere commanded admiration. In all this he never lost sight of the value of machinery, especially in practical work; but, nevertheless, he always put his emphasis on the value of the workman back of every piece of machinery. He always saw the man who designed it, or the mechanic who made it, or the operator who tended it, and he wanted Pratt Institute to reach out and help these workers, and to reveal to them both the possibilities of their work and the possibilities for their own development through even the most commonplace tasks.

With this outline of the aims and purposes of our course in steam and machine design as we call our two-year mechanical course; and also of the more general scope and purpose of the work at Pratt Institute, I will now proceed to a detailed description of our shops and of our instruction in foundry work.

I have already said that the time devoted to foundry work was limited. The whole course is two years in length and the students' time is divided among a number of subjects. A typical day for each student would be as follows: One-half of the morning in class room for mathematics and perhaps practical mechanics; and the other half on the drawing board, mechanical drawing, or machine design. The afternoon would be alternately spent in either one of the four shops, or some kind of practical laboratory work, the share of the time devoted to foundry work being about two afternoons per week for six months in the year, a total equivalent to about twenty working days of nine hours per day. All that we accomplish, therefore, we have to do in this limited length of time.

To illustrate the general character of our shop equipment and the emphasis which we place on the practical side of the instruction it may be noted that

our machine shop occupies two entire floors, having a combined floor area of nine thousand square feet. It is equipped with ninety-four machine tools of various types, the greater part of them being the most modern design, and in this floor space we can handle one hundred and twenty men at a time. The pattern shop, too, is a fine, large, splendidly lighted room about ninety-five feet by forty-two, with a model mill equipment and independent motor drives. In this shop we can handle a class of sixty men.

Both the forge shop and the foundry are in their original quarters, but we are looking forward to the possibility —which I trust may not be in the very distant future—of having a new building for both of these departments. In the forge shop we have anvils for thirty-five men at a time. The foundry, too, is housed in the same room as it was when the school started, but with the growth of our classes we have enlarged the molding floor to about three times its original area, and have decreased to a minimum the space occupied by supplementary benches. In this way we are able to handle the present large classes satisfactorily; although at the present time more space is sorely needed for the extension of the work in several directions.

The Foundry Course.

Now turning to the instruction given in the foundry course itself, I believe you would be interested in these three phases:

First—The aims of the instruction.

Second—The routine work of the school shop.

Third—The practical methods of presenting the subject.

The aims of the course briefly, are first to give our men an understanding of the underlying principles which operate in the production of sound, smooth, workable castings, to make them able to recognize the defects in a

FIG. 3—INTERIOR VIEW OF THE FOUNDRY

casting, tell the cause and suggest a proper remedy, to have some judgment in deciding the best way to make a pattern and to mold it, taking into consideration the number of castings required and the shop conditions, to understand some of the best methods of duplicating work in various quantities, both in the jobbing shop and in the manufacturing plant, to have some experience in the melting of iron and brass, and be familiar with the basic principles regarding the mixtures; to be able to make good, commercial molds and cores for any simple, light casting; to vent, gate and pour these molds so as to produce sound, clean, marketable castings of high grade, and to do this in a business-like way.

Coming to the second phase of the subject—the routine of the school shop—a few words regarding the equipment of the foundry will be of interest.

Arrangement of Foundry.

The accompanying plan, Fig. 2, shows clearly the general arrangement of the shop, which occupies a room 28 x 56 feet in a one-story ell with a small room in the basement for cleaning the castings. It is nineteen feet in the clear on the inside and is well lighted on the east and north by large windows, and has two turret ventilators with swinging windows on their four sides. Arc lights supply the light on winter afternoons.

The cupola, the base of which may be seen in Fig. II, is at one side and is charged from a platform 10 x 20 feet, suspended from the roof. On this platform we keep our coke and our supply of about six tons of pig iron which we convey there from the floor by an old though very rapid, type of conveyor, a line of men passing the pigs from one man to the next. You will see cost of labor is not the most important item with us, and this kind of occupation helps a lot toward getting the boys into the right attitude of

FIG. 4—CASTINGS ON PICKLE BUGGY

mind toward their work. The coke is hoisted to the roof and dumped through a trap into a bin on the same platform, which has a capacity of three tons. On the dark side of the room in the space underneath this platform, convenient to the cupola and molding floor, is a large box for the molding clay and facings. Here, also, we keep the pickle vat and buggy, the racks for holding the ladle shanks, skimmers and similar appliances. In the corner nearest the street door are the pits into which we dump our annual supply of molding sand and similar materials, and always have them ready for use with the least possible handling. A case for keeping the small tools used on the foundry floor is built against the wall near these pits, as shown in illustration Fig. 12. This leaves the three best sides of the shop free for the bench molding, giving us stations for fifteen men; and marked off on the foundry floor by wooden pegs are eight floor stations at which we work sixteen more men. This molding floor is laid on a bed of puddled clay with a considerable thickness of well packed molding sand on top.

The core, brass and repair benches are placed as far into the west corner of the shop as possible so as to give as much space as can be had to the iron molding. These features, however, will be spoken of in detail later.

In starting all the foundry classes we give first a graded series of six or eight preliminary lessons in making practice molds which are not to be poured in iron. Often a couple of the best of them are poured in white metal to more clearly illustrate the relation of the parts of the mold. In this work the instructor himself makes a mold for each type of pattern, doing so before the class, and all the students work on the same general class of patterns at one time. This preparatory course of instruction covers the important and most fundamental operations of foundry practice, such as packing a flask, making a joint, tucking under cross bars, setting the gaggers, making pouring basins and gates, and making and setting the simpler forms of cores.

FIG. 5—WASHING AND SORTING CASTINGS

At this point the class usually visits

some good jobbing foundry and is expected to notice especially the forms of pouring basins, the clamping of molds and the methods of pouring. Such visits are repeated from time to time during the course, to representative foundries in Brooklyn and vicinity. From this time on the heats are regularly run in iron each week, and the molding for the individual students is differentiated, the conditions being made to approach as nearly as possible to the practices in the best commercial foundries. The men are given such work as in the judgment of the instructor will keep them alive with interest and at the same time tax their power and ability enough to make them think.

Since this endeavor to approach commercial conditions holds throughout all shops and laboratories, we have, as a rule, a sufficient amount of work that is needed in the department to keep the foundry busy without resorting to the making of practice castings which have no useful purpose. And the variety in our work is always great enough so that we can give to each man some job that will inspire him to do his best.

Our first heats are usually run with a very soft mixture, into small brick-shaped blocks. These are used the following year in the machine shop for the first exercise in chipping. We make about 300 each year.

Subsequent heats are mixed to give a good strong iron suitable for general machine castings.

It will be recalled that our students practically spend every other half day in one of the shops, and two half days a week for a period of six months is the usual time devoted to foundry work.

We handle on an average about 120 men per week divided into sections of about 30 to 35 men. Of course these sections cannot all take the same thing at the same time, so some of them report to the foundry in the mornings and some in the afternoon.

Perhaps the most concise way of showing how our shop is operated will be to describe its workings for a period of one week.

Shop Operation.

For purposes of illustration we will consider that the week begins on Wednesday, as on that day we begin to put up molds for the heat.

At 9 o'clock a section reports in the shop. The men are called before the instructors' bench, and after discussing the castings they made in the last heat, a short talk or demonstration is given them in accordance with a definitely planned course of instruction. Then their assignments for the morning's work are given out and they go to the bench, floor or core bench as directed, and do their best to get out their work within the time limit, as their mark depends largely upon the castings they make.

When his mold is finished, the boy sets a small cast iron cover plate over runners and risers to protect them from accidental loose sand until pouring time. Under the edge of this he places a yellow slip giving job number of the work and weight of metal required. When cores must be set the following day the fact is stated very clearly on the same slip.

Before leaving, one man—assigned weekly—takes account of the weight of metal required by each member of the class and enters it in the proper column on the Cupola Record, which will be described later.

In the afternoon another section begins its work. This class is given more of a lecture, dealing with the general methods of manufacturing pig iron, the effect of the different metaloids on the grain and strength of cast iron; how malleable iron and steel castings differ from cast iron, etc., and topics of like character which will show the important place the chemist now holds in modern engineering.

Their time is very short and they put up only the simpler work. About every second week they run a heat in one of the alloy metals—brass, bronze, or aluminum—and when this is done, one man is given the job of caring

for the furnace. He weighs out the mixture and charges it; pulls the pot and handles the ladle.

All molds put up by this class have the weight of metal noted on a white slip, so that they can be quickly distinguished from those of the other classes.

On Wednesday the janitor (who had been trained to care for the cupola), chips out, daubs and puts up the bottom of his furnace, repairs the lining of his ladles, and gets the large core oven ready to light the first thing in the morning.

This work is done by our man because the class of students in the shop on this day is not such as would in our judgment benefit enough by the experience for us to risk their attempts at preparing the furnace.

Daily Routine.

On Thursday morning, there is opportunity for the instructor to plan out the assignments for the afternoon and see that flasks suitable for the jobs are at hand. He decides on the metal mixture for the heat and figures the bed charge.

The metal put up by the two classes already mentioned usually makes about one-third to one-half the total charge.

Fire is put in the large oven, and in it are baked the ladles and any large cores needed; and the fire is laid in the cupola. These preparations also are made by the janitor (melter) as the regular classes are occupied with other work at this time.

On Thursday afternoon a section which has been in the shop a longer time than the others reports, and to it is given the most important work as well as the job of pouring the heat. The class is divided into four groups or squads according to their positions at bench or floor, and one member of each squad is appointed by the instructor to act as foreman. The work is assigned through the foreman, and he is responsible for the molds of his gang, in the following particulars:

First. Gives out patterns (under suggestion from the instructor).

Second. Gets weight of metal from his men and reports the total to the melter.

Third. Puts up his own work.

Fourth. Assigns men to pour and skim his floor and to start various work when it comes to cleaning shop.

Fifth. Makes himself familiar with weight and type of work in each mold on his floor and keeps watch that they are not poured short.

Sixth. Makes a report to instructor, on a blank furnished, regarding assignments, number of molds up, time of men, and number of molds poured.

These reports furnish the data for cost sheets which are kept for each job going through the shop.

One man also is assigned to help the melter through the afternoon. From the reports of the four foremen he gets the total metal required for the heat and figures the remaining charges, then helps the melter weigh these out and charge the furnace. He tends the fire that dries the cupola breast, places the ladle shanks handy to the core oven, and sees that skimmers are in readiness; in fact, does whatever the melter tells him to do to help make the heat run smoothly. This man records the actual weight of charges, and the times of charging, blast, first metal, etc., and after the heat sees that all the furnace appliances are returned to their proper places so far as possible.

It will be seen from the above that while five men out of the class have rather special work, the majority of the fellows are actually ramming up molds, Fig. 3, setting cores, clamping and weighing, and in this hour and a half the bench men will put up two to four molds each and the floor men only one or two, according to the class of patterns they have.

It is not practicable to have each man pour his own mold every heat, because the space is so small. Usually four men with hand ladles pour the lines of bench work and four other men pour the floor molds, using a small bull ladle.

PRATT INSTITUTE FOUNDRY.

HEAT RECORD.

Heat No..... Poured by..... Date .....

CUPOLA DATA.

Charge.								Heat.			Results
								Fire lighted ..			Good
					Scrap	Total	Coke	Iron charged.			Poor
1								Blast on.....			Scrap
2								First metal...			Lost
3								Bottom.....			Hardness
								Gauge.....			Max. fib. str.
								Melt per min..			Si.. est. % Ac'l %

Remarks: .....

.....

SPECIAL ASSIGNMENTS.

During Heat.		Straightening Shop.	
Cupola tender		Ladles.....	
Foreman—Benches		Riddlers.	
" —Floor		Corner case ..	
On ladles	Skim	Flasks.....	
Big Bull		Patterns	
Small Bull			
Hand 1		Weighed by...	
Hand 2		Cleaned.....	
Hand 3		Ground	
Hand 4		Graded.....	

WEIGHT OF METAL UP.

Bench Molds.						Totals.				Floor Molds.					
	S.&M.D.	A. E.		S.&M.D.	A. E.			S.&M.D.	A. E.		S.&M.D.	A. E.	
1			9			Cupola							
2			10				21			22			
3			11			Bench							
4			12				23			24			
5			13			Floor							
6			14				25			26			
7			15			Figure on							
8			16				27			28			

FIG. 6—HEAT RECORD

Assigning Patterns.

In assigning patterns in the first place the order of pouring is taken into account, to get the less important pieces where they will receive the first tap of metal, or be furthest from the cupola, and the very light work or machinery casting which requires especially hot metal in a position near the stack.

During the heat the four foremen stay right on their floor and direct the order of pouring the molds; they very often skim the ladles themselves, while other men shift weight for the bench molds.

The bench molds are run first and by the time the floor work is poured the bench men have begun stripping cases, and dumping the molds. Then, when the bottom is dumped, they begin to rake out their castings and bring them over to the floor near the cupola, and start sifting a pile of sand, as all the sand for bench work is put through a No. 4 sieve after each heat to remove the shot, etc.

The floor flasks are now stripped and as soon as possible the castings are removed and the piles cut through once. A little new sand is added to all the piles after each heat to keep the sand strong.

The work of straightening up all of the benches, corner case of tools, etc., is divided among the men of the different gangs; this includes breaking the gates from the castings and separating the poor from the good castings. This ends the work of the heat day, with the exception of calling the roll.

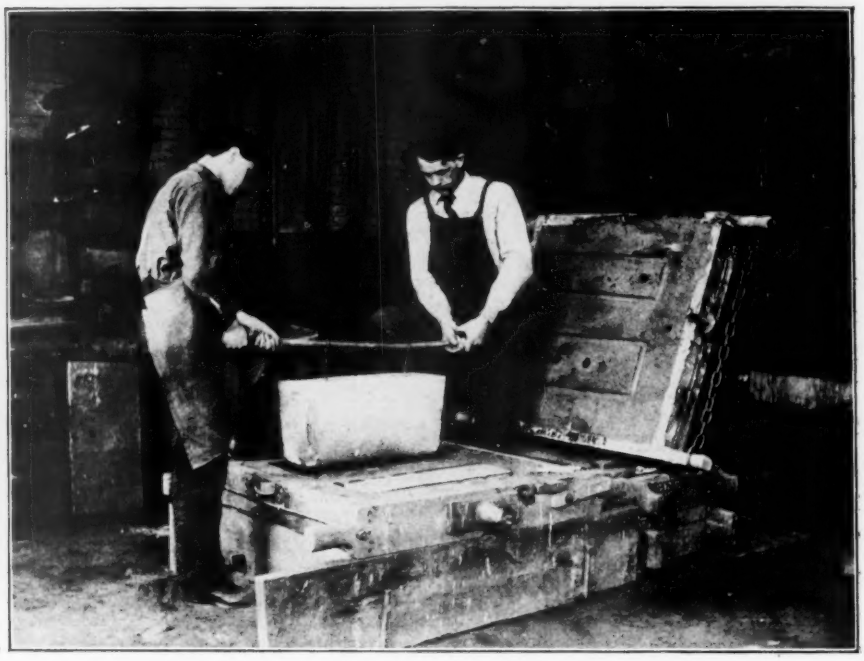


FIG. 7—SETTING A LARGE CORE

The next morning, Friday, the instructor and the janitor weigh up the result of the heat, and get the castings on the pickle buggy, Fig. 4. This gives the instructor a chance to examine every casting as it comes from the sand to become familiar with the work each man is doing, and so be able to advise him how to better his work. The janitor then clears away the dump and cuts through the sand again ready for the afternoon class.

The Friday afternoon class receives its instructions by means of lectures and demonstrations, and by putting up molds simply for practice. The men gain their experience in casting by running heats in brass or aluminum, and twice in the term they run an iron heat, the Thursday afternoon class putting up most of the molds for it.

There is no regular class work on Saturday. The morning is usually spent in checking up accounts and planning what work shall be taken up the following Monday.

lustrate methods of molding but which are not to be cast; for instance, the various ways of molding a groove pulley, ramming a flat core over a picked out detail to save making a 3-part mold; or the use of a green sand core rammed in a wooden lifting box to get over using a shallow cheek.

Two to four men are detailed to wash and sort the castings, Fig. 5, which were put on pickle on Friday. Every man taking foundry has a small 3-figure number-stamp with which he can mark every casting. The first figure or hundreds, indicates his class,

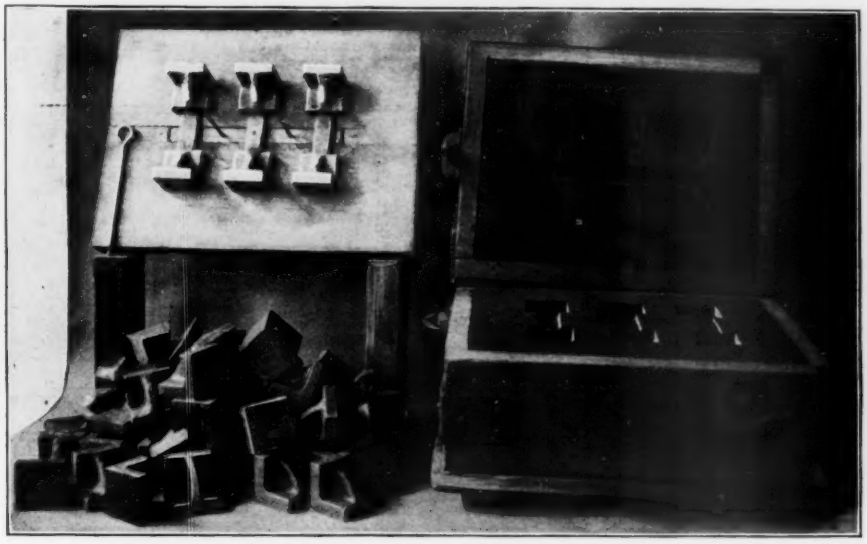


FIG. 8—SMALL ANGLE BLOCKS

On Monday morning the section that poured the heat again comes in. These men are called up and the heat of the previous week discussed and the special work to be cast in the coming heat talked over. Following this a short talk is given on some specific phase of foundry practice, as for instance core sand mixtures, routine of cupola work, foundry ladles, suggestions regarding foundry equipment and arrangement. This occupies about one-half hour. Then the men are given various assignments, as repairing flasks, fitting flasks to new patterns, making cores, or running a brass heat. Some put up typical molds which il-

the other two indicate his section and individual number. So, after washing, the castings of the various classes are put in separate piles, then these piles are arranged so the student numbers run in consecutive order. Before grinding the instructor credits each student with the number of castings he has turned out and gives him a mark for the same. These marking sheets then show at a glance just what each man in the class is turning out.

Two other men are assigned each Monday to finish any grinding that may have been left undone by other classes, and to get the finished castings properly stored. And as repair or

construction orders are filled, to weigh up and deliver such castings to the department ordering them.

Thus you will see that the whole routine of the foundry work is carried out in the four days, Wednesday, Thursday, Friday, and Monday.

Shop System.

We have in operation in the science and technology department a system of shop records, the design and use of which has developed from the urgent need of some such system. First to prevent jobs getting side-tracked and forgotten; second, to aid the instructor in keeping track of the various projects being carried out by his classes; third, to get the men familiar with some form of cost keeping.

These constitute the formal order for the work. Then, to keep track of details, each instructor as he receives the construction ticket, prepares a construction sheet, 8 x 10 inches, conveniently ruled, headed with job name and number. Upon this sheet the entries of stock and student time is made; either from foreman's reports or from time slips made out and passed in by the students who do the work.

This sheet now gives the complete history of the job, and when the work is finished the results are summed up and duly entered, first on the construction ticket and its duplicate in the drawing office. And when all shop tickets have been entered up, showing

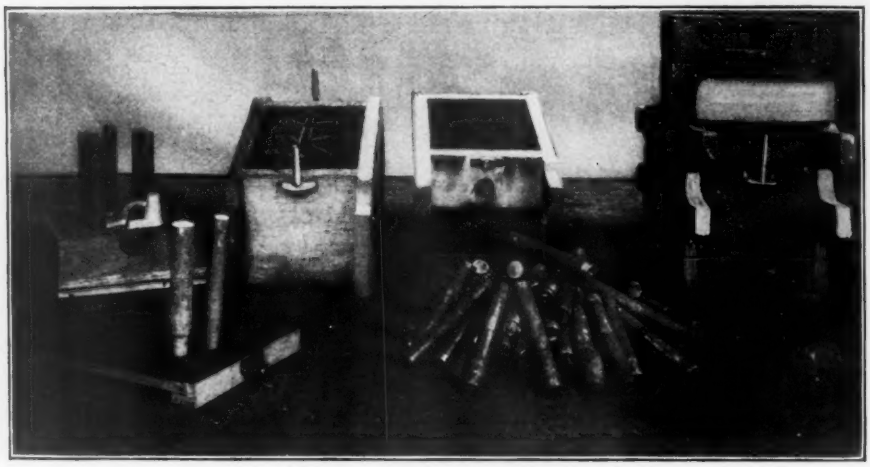


FIG. 9—SMALL CYLINDER CASTINGS

The description of the system would make matter for a paper by itself. Suffice it to say that it provides for a distinctive number for every constructive job passing through the drawing room and shops. These numbers show the department to which the job belongs, the class of work in that department, and the consecutive number in that class; with provision made by use of the decimal point, for the detailing of every part of the job.

For every distinct job a cost card is filed in the drawing room office, and construction tickets issued to every shop having work to do on the job. that the job is finished in all of the shops, the data from them are entered on the cost card, giving in condensed form the total cost of the job.

All patterns therefore are numbered according to the job to which they belong, and this number is used in all records of their handling through the foundry. By this system the foundry knows at the end of the year exactly the weight and cost of castings it has delivered to the other departments.

Foundry Records.

Another set of records which apply to the foundry work alone is systematically kept. These are the heat

records, Fig. 6, and they are arranged on a standard size sheet, as shown, and provide for entering the data, the consecutive number of the heat and the class pouring same, the number and weight of the charges of iron and coke, time of lighting fire, charging, blast, first metal and bottom, as well as blast pressure. The weight of good castings, poor castings, scrap and lost metal are also recorded with space for per cent of silicon in resultant castings, the maximum fibre stress of test bars, and record of comparative hardness of metal. This latter has not been a necessity in the majority of heats, as our castings are usually of standard mixture, which has been already tested and had given satisfaction in our machine shop. The middle section of the heat record sheet is used for making special assignments during the heat, and at the bottom is provision for noting the weight of metal needed at every position by three different sections.

The results in reference to weight of good and poor castings, etc., have been summed up each year since 1902-03 for comparison. The following table speaks for itself.

FIG. 10—SWEEPING A GREEN SAND MOLD

In looking at these figures it must be remembered that the men who turned out these castings were practically green men.

With the present year the classes of the industrial chemistry course are making analyses for us of the stock we use and the results obtained and these are brought to the attention of our

RESULTS IN SCHOOL FOUNDRY, PRATT INSTITUTE.

Year—	1902-03	1903-04	1904-05	1905-06	1906-07
Number of heats	23	23	24	23	15 to April 1.
Total weight of iron charged	18,300	21,000	19,000	27,800	19,700
Ratio—lost metal to iron charged	17*	14*	11*	10*	8*
Total weight of good castings	7,800	10,800	8,800	15,400	11,300
Total weight of poor castings	1,800	1,500	1,600	1,500	1,000
Ratio—poor castings to good	23*	14*	19*	10*	8*

*Per cent.

foundry classes in connection with the results of the physical tests on the same castings.

Core Making.

In core making the larger part of the work deals with small cores. For this we have one flat top bench at which six boys can work, and a gas core oven built in our own shop two years ago. With this we easily supply all cores needed for the general run of our work. We have four standard mixtures, using different core binders to make the men realize as far as possible the different properties of each.

We have also a brick oven, 3 x 5 x 6 feet for use on larger cores. The sand for these we mix in a large box and set the core box on a pair of horses while ramming up. As we are next door to the forge shop the boys can quickly make their rods and hangers for themselves. Our cinders are obtained from the institute boiler room down stairs.

Advantage is taken wherever possible to ram up the larger cores with lifting rods and with cinders inside, so as to illustrate the methods used on larger work and the reasons for same.

The illustration, Fig. 7, shows a core of this character being lowered into a mold for a coal box to be used on a new double forge we have built as an experiment in the forge shop. The casting is 27 x 10 x 12 inside and weighs 135 pounds.

Brass Work.

For the brass work we use a No. 0 Albany sand, held in four molding troughs which will accommodate six men with a little crowding. Iron flasks are used for this work.

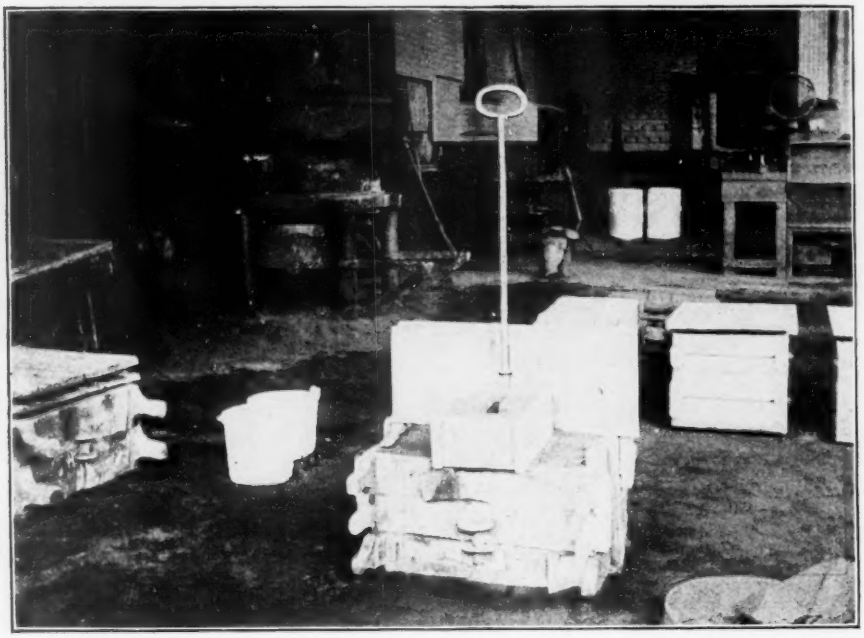


FIG. 11—MOLD READY FOR POURING

There is a twin furnace capable of holding two No. 30 pots. But the limits of the molding benches make one pot sufficient for our heats; which usually do not run over 40 or 50 pounds.

Our work here is largely for bushings and small instrument castings and a large number of electrical fittings. The slide shows a gate of line terminals left in the flask to cool to demonstrate the shrinkage of brass. For these we had an order of 50. One

master pattern with double shrinkage was given us on one Friday, and that day we cast eight off of it in white metal, and sand-papered them over. On Monday we set these in a flask and cast a gate of white metal patterns with 10-penny wire nails cast in for steady pins. This gate was scraped and finished the same morning. On Wednesday we made up a sand match and cast four flasks—all of that size we had— and we got 30 good castings from the heat. Three more flasks were poured when the section came in on Friday, thus completing the order.

We have spoken of metal patterns. A bench especially for this work was made last year. It has a cast iron top 30 inches x 60 inches, planed true to facilitate testing the work. On the bench is a soldering outfit, a Bunsen flame, 6 inch melting pot, and a 3 inch Welliamson vise. There are also drawers for storage of tools and work. The bench is near the brass molding troughs so that molds can be made up and conveniently poured.

Most of the gated work is made up in the foundry at this bench, but occasionally the work is given over to the machine shop.

FIG. 12—DRAWING CAST IRON PATTERNS

Now a week's time may seem long for a man in commercial work to wait for 50 small castings. But when the interrupted progress of the work and the inexperience of the men actually doing the molding is taken into account, it will be seen that we are a whole lot nearer the commercial practice than the average school shop. And if you will bear in mind that the actual time for getting out the gate of patterns and 50 castings was but 10 hours, it will emphasize this point.

Typical Jobs.

The third phase, the practical methods of presenting the subject of foundry work, has already been touched on several times in the course of this paper, but here are a few definite problems from this year's work which are typical of the jobs that come in to us right along.

Since our various departments often require a fair quantity of the same cast-

ings, we take advantage of this to demonstrate to our men the value of good rigs for duplicating castings. Gated patterns for some brass fittings have already been mentioned. Here is a gate of small angle pieces, Fig. 8, from which we get eight molds a heat, whenever we run the very soft metal needed for the job, and we have four gates working, giving us about 130 castings a heat, allowing for losses. We make 250 of these each year, and increase the men working on them so as to get the lot out in but two heats.

A rig for the floor is shown in Fig. 9. The job is to make 350 perfectly parallel cylinders, 1⅜ inches x 8 inches for use in the machine shop. They must be sound and free from blow holes for fine threads may be cut on them. As may be seen we have connected the runner with a skimming gate to insure clean metal and draw the separate cylinder patterns through a stripping plate to give a parallel mold.

Our first rig was designed and made about three years ago when we only required half the number of castings. The patterns were made of seamless brass tube and were fitted in iron bushings to be drawn with a ¼ inch draw screw, the other parts were of wood. Early this year we got up another rig. The patterns are of mahogany, and made long enough to project through the stripping board 2½ inches. This does away with the necessity of a draw screw. We used the other rig as a pattern, and made the gate and skimgate patterns of aluminum. The whole thing was constructed inside of a week by two or three men assigned from each of the foundry classes to push the job through. Special flasks and iron pouring boxes are used for this job, and extra long weights made which may be shifted very easily. The whole outfit suggests to the men manufacturing methods. With the two rigs we can turn out about 50 or 60 cylinder castings at each heat.

To demonstrate further the resources of foundry methods we swept up a couple of molds this year in green sand. We wished two round covers for the brass furnaces. We did not want either the delay or expense requisite on a finished pattern. We therefore cut two sweeps, and having swept up the sand pattern and lifted off the cope, we changed sweeps and worked up the drag mold, Fig. 10. The illustration, Fig. 11, shows the handle bar bolted to the cope, the pouring basin cut and the mold clamped ready for pouring.

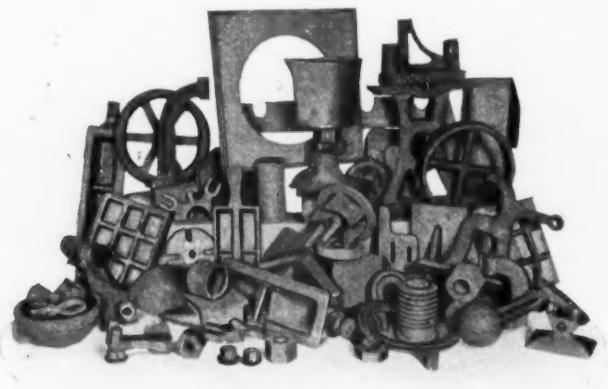


FIG. 13—GROUP OF SMALL CASTINGS

We make two sizes of surface plates which are cast with the face down to insure sound metal. The larger one, 18 inches x 24 inches, weighs 180 pounds, and is made in a skin dried mold. The ribs are made loose on the pattern to facilitate pinning the green cores which

hang from the cope. The smaller plate, 8 inches x 10 inches, is made by hanging a core in the cope to illustrate this method of supporting a core.

We are now building a molding machine in our shops, the castings for which are practically completed. It is of the hand rammed, stripping plate type, and we expect to rig up a few typical jobs on this to set the men thinking along these lines. In Fig. 12 may be seen three students drawing a cast-iron pattern for a gear wheel by means of a triplex block on the overhead trolley. The casting forms part of a hoist we built this year for the foundry. Fig. 13 shows a representative group of small castings turned out by our shop.

It will be noticed that we have practically none of the labor saving machinery which is found in many modern shops. The reason for this will be apparent upon a little thought. Our men are with us but a short time, and we want to help them to acquire as much skill in molding as possible and also some insight into practical foundry conditions. Now the productive labor saving devices, such as core machines, power molding machines, etc., are for the express purpose of employing less skilled labor, and for that reason do not fit our purposes. And as regards the sand shakers, they would undoubtedly save manual labor, but we are training men to go out into actual commercial works, and a most important thing for many of them to learn is to do with a will the thing he is told to do whether he particularly likes it or not. And in our judgment the moral benefit to those men buckling down and cutting through a floor of sand after a heat, and of snagging and grinding casting is greater than the physical strain or loss of time to them in doing the work this way.

While I said at the outset that our courses are not primarily aimed to train master foundrymen, we do believe that they are of very great value for any young men who are looking forward to such work.

We further believe that all of the instruction that is given in pattern making, forging and machine work, to say nothing of the mechanical draughting, mathematics, practical mechanics, and power plant operation, would be of inestimable value. In fact should we plan a foundry course, it is doubtful if we should wish to omit a single one of these subjects. Every one of them has, we believe, a most important bearing on modern foundry practice, and should be included in every wisely planned foundry course.

The intelligent modern foundryman certainly wants some knowledge of the laws of mechanics and properties of fluids, and he should understand something of power transmission and power generation, too, for that matter. He should know how to read and make a working drawing, and he will have a broader view of his work if he has had some experience in the making of patterns, knows how to make a weld or temper a tool, and has had an opportunity to machine the castings that he has produced under various conditions and with different mixtures.

I think you will agree with me, therefore, that all of these things are needed in the ideal foundry course, and that this work which we give in our present mechanical course supplements in a most useful and efficient way the practical instruction which we are giving in molding and foundry work.

We are well aware that there are other things that would be useful and which we very much wish the time permitted us to include with the instruction we now give as I have just described to you. But the limits of a two years' course will not allow us to cover everything.

As I have already indicated, we are doing something along the chemical side and we are trying to get the boys to understand the relation between the chemical and physical properties of the metals as much as possible. We are also doing something in scientifically testing the physical properties of our material. And we are paying a good deal of attention to methods of

duplicate production, and other economic foundry problems. We only wish time permitted us now to carry these lines of investigation as far as we hope we may be able to in the future.

And in closing you may be interested to glance at a few figures which demonstrate the growing demand for the kind of training we stand for. In a period of ten years the growth of our classes has been nearly four-fold as will be seen from the following table:

Year.	Day Courses.	Evening Courses.	Total.
1896	68	263	332
1900	136	363	499
1904	241	578	819
1906	284	783	1,067
1907	331	841	1,172

CAST STEEL CAR WHEELS.

Cast steel car wheels are now being successfully made at one of the East St. Louis, Ill., plants of the American Steel Foundries, Chicago. This is undoubtedly the greatest triumph of the steel founder in recent years and inasmuch as wheels have already been in use for the past six months it would seem that the venture will prove commercially successful. The experiments which led to the perfection of the method of molding and castings covered a period of practically four years. For casting the wheel the revolving mold principle for compressing the metal in the tread and flange is utilized, the mold revolving at a speed of approximately 600 revolutions per minute. As it requires about 15 seconds to cast, the mold is revolved 200 times in this period. Inasmuch as a green sand mold would break down at this speed, dried molds are used, which withstand the wash of the metal. The steel enters the mold under considerable pressure from a basin connected with the center gate, and in that portion of the metal required for the wearing surfaces, including the tread and the flange, manganese, in the form of powdered ferro-manganese, is introduced by a secret process. This results in the formation of practically a high manganese steel where the greatest strength and highest wearing qualities are required, while the web and hub, in whose metal no manganese is introduced, remains of a mild quality. The castings show no line of demarkation between the high manganese and other sections, the change being gradual as in the blending of the chilled and gray iron parts of the cast iron wheel. An important part of this process is the annealing which must be done carefully, so that the temper of the wearing surfaces remains unchanged. The castings are heated to a bright cherry color to relieve the internal strains and while cooling the tread and flange are sprayed with water to restore the temper that may have been lost in heating.

Wheels that can successfully withstand the tests to which 700-pound gray iron sections are subjected, weigh only 550 pounds, and this reduction in weight is a factor of prime importance in view of the tendency to constantly increase the weight of railroad rolling stock. Their cost at present is about double that of the gray iron wheel, and considerably less than the rolled and steel tired wheels.

DETERMINATION OF COKE QUALITY FROM ITS APPEARANCE.

In a recent issue of *Gluckauf*, Mr. Thau details a series of observations based upon analytical data of the quality of coke when judged by the eye only. The author concludes by summarizing the following characteristics for coke with a high content of ash: (1) Has impurities consisting of incombustible substances; (2) dark sandy appearance, with a great abundance of pores; (3) exceptionally high weight; (4) edges of the pores appear with metallic luster in the fracture.

A high content of volatile ingredients is shown by the following characteristics: (1) The coke falls without sound when dropped upon a hard surface; (2) it has a black appearance, without luster; (3) it contains small blue-black spots in the fracture, due to uncoked coal; (4) it appears in thick pieces which break apart easily; (5) the interior of the pores is deep black and the edges have a tarry luster.

METALS IN FOUNDRY PRACTICE

Questions from Practical Foundrymen are answered in this department by the following experts:

CAST IRON . . . . . W. J. KEEP
MALLEABLE IRON . DR. RICHARD MOLDENKE
METALLURGY OF STEEL . . . J. B. NAU
STEEL CASTINGS . . . . W. M. CARR

Other experts also contribute Address all inquiries to the Editor

CAST IRON NOTES

W. J. KEEP

Question:—I am making stove plate, light machinery and jobbing work, pouring from 8 to 10 tons a day. I am unable to explain the loss of silicon during the heats, and would like to have you explain the problem to me. I figure the silicon as follows:

Pig iron	300	pounds	× silicon	2.03	per cent	= 6.09
Pig iron	1,000	pounds	× silicon	2.25	per cent	= 22.25
Pig iron	150	pounds	× silicon	9.10	per cent	= 13.65
Pig iron	1,450	pounds	× silicon	2.89	per cent	= 41.99
Sprues	900	pounds	× silicon	2.70	per cent	= 24.30
Total	2,350	pounds	× silicon	2.82	per cent	= 66.29
				2.70		
				0.12	per cent loss.	

This gives 2.82 per cent of silicon for the mixture put into the cupola and 2.70 per cent for the iron taken out. Is there any difference in the loss of silicon in pig iron and sprues, and if so what is the per cent?

Answer:—I should say that there was a mistake somewhere. The sampling for analysis may not have been made carefully. The loss of 0.12 per cent silicon is too small. It is usual to calculate 0.20 or 0.25 per cent silicon as the loss in remelting for stove plate mixtures. The more the surface exposed the greater the loss of silicon. Sprues remelted should show a greater loss than pig iron remelted.

ETCHING ON CAST IRON.

Question:—I would like to receive instructions regarding the etching of ornamental figures on smooth cast iron surfaces?

Answer:—Warm the surface to be etched. Smoke the surface and melt a thin coat of beeswax over it. When cold scratch the desired figures in the surface and pour on dilute aqua fortis. When it stops boiling you can wash it off and apply more until the desired depth is reached.

EXPANSION OF CAST IRON IN COOLING.

Question:—You stated in cast iron notes, September, 1905, that cast iron expands after it has become solid and while at a dull red heat. You speak of a machine that shows the expansion by a curve. What is the use of such a machine and please give a clearer reason why the iron expands in cooling.

Answer:—The recording pencil moved exactly as the iron test bar moved. One end of the test bar was held rigid while the other was free to expand or contract. The motion of the free end of this test bar was autographically recorded by the pencil; that is, the recording

pencil was attached to the free end of the test bar.

There was no motion of the pencil until the test bar became solid, because fluid iron could not move the pencil. For a few seconds after the test bar became solid the motion of the pencil showed that the test bar was contracting. Just as the test bar was losing its red color it suddenly expanded.

Another way to prove that cast iron expands is to take a ladle of melted iron and drop into it a clean sprue. It will sink and drop out of sight, but in a moment it will rise to the surface and a part will be above the surface, showing that the solid iron was at first heavier than melted iron but when it became red hot it was lighter.

The use of the machine to make these autographic curves is to show the composition of the metal, by the shape of the curve.

LOSS OF IRON IN REMELTING.

Question:—With fairly good cupola practice what is the melting loss when using pig iron alone, and what is the loss when rusty stove scrap is used alone?

Answer:—The loss with pig iron alone is about 4.75 per cent. The loss in melting rusty stove plate scrap alone is 11.35 per cent.

These results were obtained by melting one ton and carefully weighing everything. In ordinary stove plate practice, and with ordinary help, the records often show no loss, but in one very carefully conducted 37 ton heat the loss was 4.41 per cent.

MIXTURE FOR VALVE CASTING.

Question:—Will you kindly give us a good mixture for valve castings, the walls of which are about 1¼ inches thick and flanges 2 inches thick. A close grain is desired, as the valves will be used for superheated steam.

Answer:—To make close-grained castings, use close-grained pig iron or scrap. If the iron you charge into your cupola is close-grained, the castings will be close-grained. Scrap is used instead of pig iron for the reason that the founder can see that the mixture from which the scrap was made was such as to produce a close grain. Pig irons that contain a small percentage of silicon are close-grained, therefore the low grades are used. Northern irons are better for valve work than southern irons, for the reason that they are not as liable to form spongy spots in places where two walls meet. Probably the reason is that northern irons contain lower silicon, which cause the iron to set quicker. Make the casting as hard as you can, and still be able to machine it.

OIL SAND CORES.

Question:—Kindly give me a receipt for oil cores as near as possible to manufacturers' compound, for piston head cores.

Answer:—Each founder must decide how to use the different compounds that are offered and whether they are as good as raw linseed oil. The larger the core the less oil required. For small oil cores 28 quarts of pure sharp sand to one quart of oil. Mix the oil with the sand, cut over twice and pass through a No. 6 riddle three times. The mixture should be dampened with water sufficient to work well. If the sand is perfectly dry it would need about one-half gallon of water. To make the best core mixture, take one-half gallon of *boiling* water, mix with it one quart raw linseed oil and add it to 28 quarts clean, sharp sand. Cut twice and pass three times through a No. 6 riddle.

BLOW HOLES IN CASTINGS.

Question:—We frequently have castings that look perfectly sound outside, but are merely shells, being hollow in the center. Can you tell us the cause of this trouble? Some of our molders say that it results from the use of bad iron, while others say that the molds are rammed either too hard or too soft.

Answer:—Blow-holes can often be avoided by melting iron hotter or pouring it hotter. In your case, it looks as though the trouble was with sulphur. Scrap iron contains the limit of sulphur, and melting it over again gives it an extra dose. Sulphur seldom comes from the pig iron, but from the coke. Your coke, and in fact, nearly all coke as

now supplied to the foundry, is too high in sulphur. The limit should be 0.75 per cent, but it will often run over 1.00 per cent. Your scrap will contain 0.075 per cent. Suppose that you are using ⅜ pig with sulphur 0.02 per cent, and ⅜ scrap and ¼ remelt containing 0.08 per cent, you have a mixture that will contain 0.056 per cent sulphur. Coke with 0.75 per cent will add to this 0.03 per cent. Your casting should therefore contain 0.086 per cent, which will be likely to give you trouble. But suppose your pig iron contains 0.05 per cent, and your coke 1.00 per cent. Your castings may contain 0.1 per cent. Plenty of limestone or a little fluor spar will reduce the sulphur. Using pig iron with manganese about 1.00 per cent will help a little. Powdered ferro-manganese in the ladle will also take out a little of the sulphur. When the iron fills the mold a very thin skin becomes solid all over the surface of the mold. When gas forms it cannot force its way through this skin, and a blow-hole results. If the iron is poured very hot and the mold is not too hard and is thoroughly vented, the gas will break through the skin and fluid iron will flow in and fill the space and make a sound casting.

CHILLS FOR ROLLS.

Question.—What is the right thickness of a chill for a roll about 12 inches in diameter?

Answer.—The depth of chill on the body of a roll is made to suit the purpose for which the roll is to be used. If the roll is to be finished plain for sheets or plates, then a shallow chill only is required. If it is to be afterwards finished with grooves, then the chill on the body of the roll should be deeper. For such rolls 2 inches and 2½ inches depth of chill is sometimes demanded. For large plate rolls, sheet rolls, tin plate rolls, and rolls for sheet copper, brass and zinc, the safe depth of chill is embraced between ⅝ inch and 1⅛ inch, and preferably from ⅝ inch to ⅞ inch. Users of tin plate and sheet rolls, as well as rolls for copper, brass and zinc object to unnecessary depth of chill as operating against the strength of the roll, preferring a reasonably shallow chill.

A. C. B.

TROPENAS STEEL CASTINGS.

W. M. CARR

Question:—Will you kindly tell me the composition of facing sand and blacking used for casting Tropenas steel in green sand?

Answer:—The composition of facing sand in green sand molds varies in different plants. In some sections of the country silica sand is used to which must be added varying proportions of plastic fire clay to give a necessary bond. In other localities some silica sands have a natural bond and therefore require no treatment other than grinding and tempering. Since I do not know from which point you are writing I cannot therefore give you definite compositions of green sand mold facing.

The blacking for coating molds should be pure graphite. It is sometimes mixed with finely ground silica sand. The graphite or mixture may be used dry and dusted on the faces of green sand molds; or the materials may be suspended in a solution of molasses water and applied as a wash.

Question:—Why is an annealing furnace unnecessary when using the Tropenas method? Is it on account of molding in green sand or is this kind of steel more suitable for castings than other kinds? Must an annealing furnace be used when the castings are large and are cast in dry sand molds? Is Tropenas steel more suitable for casting green sand than other kinds of steel? If so, why?

Answer:—Tropenas steel does not possess any peculiar property that dispenses with annealing. Open-hearth and crucible steel castings are frequently shipped without being annealed.

The character of the mold either green or dry sand into which Tropenas, open-hearth or crucible steel castings are poured does not control the annealing process, neither do the

shapes or sizes of the three varieties of steel castings determine whether they should be or should not be annealed. Steel castings of any variety are annealed when specifications under which they may be sold so demand.

Green sand molds are preferred in Tropenas or other steel casting methods because of their lower cost and for no other reason.

There is no material difference in general steel castings made by the Tropenas method in comparison with similar castings produced by other processes, so far as quality is concerned.

SOUND CASTINGS.

DAVID SPENCE

There is at present a great demand for castings for printing machinery and tools, and being actively engaged in that line, I have made an effort to develop details in practice which have given most excellent results. Thus the matter of a little gate enables me to get out castings of printers' rolls, clean and sound, with no loss, while formerly the percentage was very high.

When I first worked in the foundry, the method in vogue provided for the use of a storage catcher on the mold, and to run castings with a small gate using a large basin to hold the iron. This was very good. Later came the needle sprue system which was a step far in advance of the old way of bringing the work sound and clean.

Now that we have a variety of patent gates, each good in its way, we can get printers' rolls and gear blanks as sound and clean in green sand as if made in loam or dry sand.

While in Chicago, I called on a firm using many gear blanks and was asked to guarantee the defective work down to 5 per cent. I did it, and out of an order of 300 gear blanks of various dimensions, less than 5 per cent were defective. These were all made by running them on the hub, with four small spindle gates and a large basin running across the flask. The iron used was hot and fluid. I always advise the use of iron not too hot nor too dull, but preferably the hot. The molder has his part to play also to get good sound castings. That part is to make a good clean mold, well vented, so that the removal of the gases may be readily accomplished. The molding sand should be good and open with not too much loam in it.

For facing for printers' and laundry rolls I use five parts molding sand, one part fire sand, and one part of sea coal with a little flour. This all mixed together and dampened with stale beer or molasses water and gives fine results.

The iron used should be low in sulphur, close grained, and a small percentage of car wheel scrap should be added, as well as high silicon iron to insure the proper softness. The middle of the heat is where I prefer to take the iron for this special work.

For the last 25 years I have given considerable thought to the subject of mixing iron for foundry work, and must say that at our conventions I have always found some valuable points along these lines. We are doing much in this quiet way for the thinking man of the foundry, and I need not tell you that we need thinking men in this industry, as well as in any other branch of manufacture.

*Presented at the Philadelphia Convention of the American Foundrymen's Association.

A NEW REFRACTORY MATERIAL.

A new refractory material for use in pyrometer tubes, pipes, muffles, plates, crucibles, etc., is being introduced in this country by the Wilson-Maeulen Co., 110 Liberty street, New York. This material, which is known as electroquartz, is composed of fused silica, a pure silica product of the electric furnace. It is stated to have all the properties of the quartz product made from rock crystal except transparency. The maker states the material possesses a low coefficient of expansion, thereby permitting it to undergo violent temperature changes without cracking. It will withstand a temperature up to 1,400 degrees centigrade (2,552 degrees Fahr.), at which temperature it softens. The melting point is 1,600 degrees centigrade.

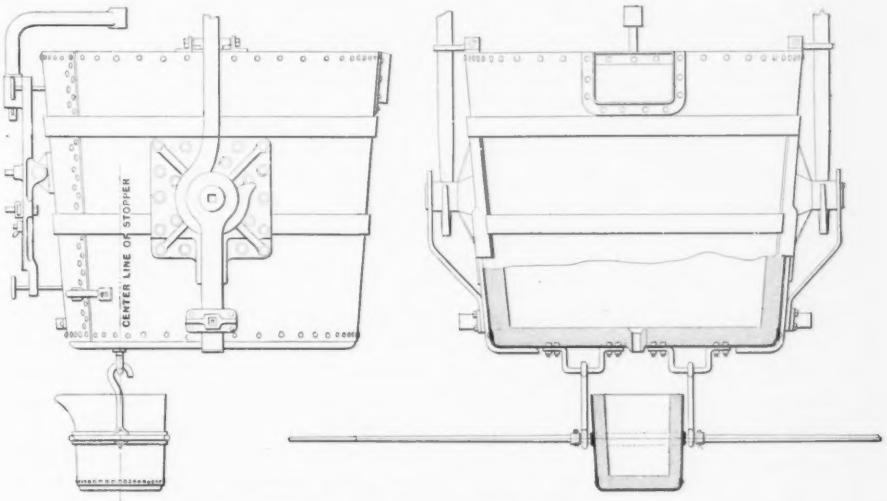
COMBINATION BULL AND POURING LADLE

Designed for Pouring Small Castings and Sections Requiring a Special Composition

W. M. Carr

IT FREQUENTLY occurs that foundries fitted with open-hearth furnaces only receive inquiries for special composition castings not easily made, particularly where the quantities desired are smaller than the capacity of a single heat and when it would not be convenient to depart from the daily grade of steel produced. They are therefore compelled to forego such business, which is allotted to plants with crucible melting furnaces or small converters. Again, it is sometimes desired to pour very light castings from open-hearth steel. The bottom pouring ladle may be fitted with a nozzle much too large to accommodate a pouring gate proper for small castings. To open the stopper only slightly, and guard against a too large stream of metal, would give but a drizzle or dripping of steel through the nozzle, which would cause miss-runs and defective castings. The use of a pouring gate greatly in excess of the size of the casting would result in a low yield of saleable product.

Castings weighing ounces can be poured from open-hearth metal, but to make the practice economical they should be poured over the lip of a ladle. In that way the size of the gates can be materially reduced and the flow of metal over the lip can be regulated to suit conditions. A ladle full of metal holding 10 to 20 tons can be best arranged for bottom pouring. It cannot be well tilted to deliver over the lip. The stream would be too large for small work and the operation would be too slow.



Combination Bull and Pouring Ladle

To suit departures from usual open-hearth methods to meet irregular requirements, the following plan has been evolved. Reference to the illustration herewith given will show a method recommended to add some flexibility to ordinary open-hearth practice. A small, or bull ladle can be suspended from the bottom of the regular size

ladle below the nozzle, or it may be supported by some other means, permitting of ease in filling with metal, and thus in case of special compositions any treatment may be given before pouring into molds over the lip of the smaller ladle. The ladle may be detached and carried to another point, or it may be manipulated as it hangs from the larger one. The capacity may be 200 pounds or more. The ladle should be thoroughly preheated before use to prevent undue chilling. Special composition castings can be poured by this method only in cases where the element or elements to be introduced are to be in excess of any single element or combination of elements already present in the metal to be treated. The introduction of the element or elements can be brought about by the use of ferro-alloys such as ferro-chrome, ferro-manganese, ferro-vanadium, ferro-phosphorus, carburite, C. P. manganese, etc. The predetermined portions of the alloys should in every case be preheated to assist solution and to offset any undesirable chilling. The temperature of the mixture can be raised to proper casting condition by inserting in the ladle of special steel a thermit cartridge. In addition to the elevation of temperature there would be set up an agitation which would tend to thoroughly incorporate the dose or doses with the molten metal.

Thermit can also be successfully used in a similar manner in connection with the secondary ladle plan and produce a temperature sufficiently high to permit lip pouring of the lightest possible sections from regular open-hearth steel. In some open-hearth steel foundries the demand for special composition and very small castings is met by using a coke or coal fired furnace in which empty graphite crucibles are thoroughly heated. They are withdrawn at the proper time and immediately filled with metal delivered through the nozzle of a ladle holding open-hearth steel. The metal thus transferred to a hot crucible can be given any desired treatment, as described in the secondary ladle method, and then be lip poured into molds.

BRITISH NOTES.

Foundrymen have been singled out for honors lately in connection with the South Staffordshire Iron and Steel Institute. Robert Buchanan has been chosen president to succeed William Somers. Mr. Buchanan has also for the second year been reelected president of the Birmingham Branch, and for the first two years was president of the British Foundrymen's Association. He has a wide reputation as one of the shrewdest and most advanced of British foundrymen, and is never weary of impressing upon his fellows the enormous advantage of thorough scientific knowledge. Somewhat curiously, the most prominent speaker at the annual banquet of the South Staffordshire Iron and Steel Institute was another foundryman, Mr. Buchanan's colleague and successor, Herbert Pilkington, now president of the British Foundrymen's Association. Mr. Pilkington is manager of the Sheepbridge Coal & Iron Co., and prior to holding his present position worked for some years in the United States.

The death is announced of Arthur Haynes Siddons, of Beeches Road, West Bromwich. Mr. Siddons died at a comparatively early age and was well known to many Americans as a member of the firm of J. & J. Siddons, Ltd., hollowware manufacturers, of Hill Top, West Bromwich. This is probably one of the oldest firms among British foundries and for many years Messrs. Siddons devoted themselves to the casting of small domestic ware, such as coffee mills, smoothing irons, fire-grate fittings, and many articles of this class. For many years the firm had a world-wide export trade. Mr. Siddons' death was due to a paralytic seizure, following upon a period of ill health, which prevented him for some time from taking part in the business affairs.

The Tutbury Engineering Co., Ltd.,

engineers and founders, have recently acquired the business recently carried on by the New Trades Progress Co., Ltd., at Tutbury, Burton-on-Trent. The new company have purchased the whole of the land, buildings, machinery, plant, tools, etc. They propose dealing with castings in most useful metals, with a preference for iron and brass. The foundry is being extended and equipped, with the object of producing high-class castings, especially for motor-car requirements. The company purpose making a specialty of motor-cylinders and similar castings.

The rapid rise in pig iron is somewhat disconcerting to Birmingham and Midland foundrymen, who recently met to consider the necessity of putting up prices in view of recent pig iron advances. Trade, though fairly brisk, is hardly vigorous enough to tempt manufacturers to advance prices, and the situation has practically been saved by the fact that the best qualities of pig, such as Staffordshire cold blast, are so far unaffected. The last named high quality is still selling at £5-15. At the same time lower grades of foundry pig are very materially affected, for the reason that a large part of the exported metal is for foundry purposes. For the present, the association have decided to retain existing prices.

A new firm is about to be established at Middlesbrough under the management of H. B. Toy, lately general manager of Messrs. C. Akrill & Co., West Bromwich, Birmingham. The last named firm has an excellent reputation for high-class castings and it is a matter of some significance that the new firm constitutes the first real attempt to produce chilled rolls in the northern district. Hitherto these rolls have been bought outside, and as a rule from Birmingham. The promoters of the new company, of which Mr. Toy is managing director, are very hopeful that a large amount of trade, which has hitherto found its way to Birmingham, will be retained in the Middlesbrough district.

The Birmingham and Black Country foundries have been very busy for a long time and have still some months work ahead. Makers of rolls have enjoyed unusual trade, largely owing to the demands of the tin plate trade and the big business done in sheets, both trades involving a good deal of wear and tear in the way of mill plant. For foundry work generally trade seems to be increasing by leaps and bounds. There is a big output of electrical equipment, and the gas engines are taking a lot of castings. A big foreign trade is being done in machine tools, as well as in electric plant work.

An important change has taken place in the Birmingham brass foundries in the more extensive adoption of larger melting furnaces. Many establishments have lately introduced the large M. R. B. furnace, an appliance capable of melting 440 pounds of metal at a time. The arrangement is much more economical, as it prevents duplicate and in some cases multiple melting, and there is no necessity for the mixing furnace used for running brass into ingots. The operation is done in one operation, and the mass of 440 pounds of metal is distributed through smaller ladles.

There are complaints about the state of the brass foundry trade in Birmingham. Generally it is described as bad, the explanation being the very high price of metal, which it is said is simply killing the trade. Everything has been done in the way of scraping up all the old metal available, but this plan has now been worked to the end.

One of our most widely known iron founders, Alderman Charles Akrill, died recently. He was the principal shareholder in the Golds Green Iron Foundry, which he purchased in 1878. His career commenced by means of a chemical success in connection with a large chemical works at Stratford-le-Bow, London. The firm has a wide reputation for the

high quality of its chilled and grain rolls, which have been sent in large quantities to the north of England and the continent, and the demand has recently led to a large extension of the productive plant. For many years Mr. Akrill took an active interest in the public life of West Bromwich, being alderman, and for two years mayor. About six years ago his health failed, and he has since been completely incapacitated.

The first indications of resentment over the new government regulations for brass casting are already apparent. A special meeting of the Walsall and District Chamber of Commerce have considered the new regulations which it was pointed out affect 40 out of the 200 firms connected with the Chamber. E. J. Shaw, a leading brass founder, took strong exception to the requirement of an efficient exhaust draft for the removal of fumes of the casting shop, contending that the present system of open windows and a large open space in the roof was sufficient to clear away all fumes. The same speaker contended that so few manufacturers had the requisite mechanical equipment that special power would have to be installed. The further provision requiring employers to supply a lavatory under cover, clean towels renewed daily, soap, nail brushes, and hot and cold water, was also condemned. A different reception, however, was given to the proposal to exclude females from casting shops, and to the requirement that work people shall wash their hands before leaving the shop or partaking of food. Another manufacturer pointed out that when soap, water and towels had been provided, the men would not be induced to use them. Several speakers declared that the Walsall fumes were nothing to those of Birmingham, where half a ton of metal was melted at once. It was decided to communicate with the Home Office asking for a modification of their requirements.

HOW MUCH SAND SHOULD A MOLDER USE?

In the April issue of THE FOUNDRY there appeared an article that seemed to be aimed at the careless foundry foreman, the writer stating that he worked on one floor for three years and during that time used only three or four wheelbarrows of sand per year. It would certainly be interesting to learn the size of his molds, the weights of his castings, and whether or not the latter were faced, because if they were, a mixed facing might have aided materially in increasing the size of his heap every day. Other questions might be propounded regarding the nature of his work and whether or not he secured sand from the gangway, or whether any kind of sand answered the purpose. I once had a job that required a flask 14 x 15 inches, and the casting weighed about six pounds. I went to the sand shed every morning and got a riddle full of new sand and after working on the job three months my heap filled just as many flasks and no more than when I started the job. I wasted no sand, as the sand bin was too far away. I estimated that the riddle full of new sand weighed about three pounds, and if I worked one year or 300 days on that job I would have used close to 9,000 pounds or 4½ tons in wheelbarrows of sand. The question of how much sand to give a molder is an interesting one and should be more widely discussed. How to get good castings with the least amount of sand should interest all of us.

JOHN LUDWIG, Detroit.

SCRAP IN PANAMA.

In disposing of the vast quantities of scrap along the line of the Panama canal the government has sold 700 old French dump cars to the Philadelphia firm for $4.15 per ton. It is estimated that each car contains about four tons of scrap. The buyer has to see to the breaking up of the cars and the shipment of the material to the United States.

THE MALLEABLE FOUNDRY AS A BUSINESS VENTURE*

Discussion of the Advantages and Disadvantages of Engaging in this Industry

DR. RICHARD MOLDENKE

HARDLY a week passes but that I receive inquiries regarding the cost of establishing malleable castings plants. The answer I have to write invariably is: "Unless you have at least five tons daily to make—don't."

When one has personally gone through the building of a great establishment, and has the making of hundreds of thousands of tons of malleable castings behind him, caution is the order of the day, and unless the quantity is sufficient and the deliveries from outside unsatisfactory, it is wisest to buy from existing plants rather than to venture upon the little known fields of the heat treatment of white cast iron, for that is what the malleable casting industry comes to in the final analysis.

As a rule the requests for information come from those iron foundries which get orders for plenty of gray iron castings with a sprinkling of malleable, and possibly some steel castings also. The high price they have to pay outside for small lots naturally interferes with their legitimate profit, and hence the desire to produce for themselves. I believe that when the electric furnace is perfected, or made commercially possible, that a different aspect will be given to the case, but at present we have to take things as they are.

The question of embarking into the malleable casting business resolves itself into a market for the work to be produced, and the location to make that work at the lowest cost. It is very rare that a location is picked out unless the territory tributary to it can support a comfortably live malleable plant. Those concerns which use a large quantity of these castings are the natural pioneers for a given region. The fact that they can make money where they are would be a pretty good guarantee that they can either save money or get their desired deliveries by going into the malleable casting business. Moreover, their profit as manufacturers will carry them over the two or more years of loss in starting the malleable plant.

Advantages and Disadvantages.

To sum up briefly the advantages and disadvantages, I give the following:

(1)—The expanding market for malleable castings, and the great room for improvement in most of the producing works, gives a living chance to the man to go in the business, provided he understands it thoroughly.

(2)—In times of prosperity, plants in existence, where great caution is exercised, must turn away large quantities of offered work, being unable to produce it.

(3)—The moment the malleable castings works are full, deliveries are so desperately bad and slow that attention is turned directly to new enterprises coming in.

(4)—The adaptability of the malleable casting to specialties in railroad, agricultural and hardware lines, is such that the beginner has a good chance to succeed provided his specialty is good.

(5)—Where absolutely good material

*Presented at the Philadelphia convention of the American Foundrymen's Association.

is required, it pays the consumer of malleable castings to go into making these himself, provided he has enough tonnage. Only he who knows how easily one can slip up on the quality of the malleable casting, also knows how often this is done, and the customer is not the wiser.

(6)—The malleable product from its adaptability to specialties, and comparatively light castings at that, means a production in quantity of each separate piece. Hence it is not a question of half a dozen castings, but oftentimes several hundred thousand, or in other words continuous production, with comparatively well regulated and systematized shop cost.

Now the disadvantages follow from the above:

(1)—The expanding market while making room, also leaves very empty shops in dull times, for the existing plants usually expand with each high wave of prosperity and manage to hold the desirable customers.

(2)—Where the work turned away by the full plants is taken by the beginner, it is at either lower prices, or if at high prices, is lost again when these fall. The ability of the founder who commences, to hold customers who may have been exasperated elsewhere, or his ability to produce cheap enough to cut under, or most likely his having a specialty which pays the freight, will make or break him.

(3)—The high capital required is a great detriment, being about four times as much as for the same tonnage in gray iron for the works alone. This means more than appears on the surface. The malleable casting process is intricate, the chances of loss great, and it takes fully two years to get a desirable class of men in the shop, after all the bums of the country have passed through it. Hence the chances of no profit, if not worse, for a long time, which must be met and carried until success appears. To give an instance, a rough calculation of the cost of a shop to produce 50 tons of castings daily would come up to say $250,000. By the time that shop would be actually producing the 50 tons daily at a normal shop cost, over double the amount of money will have been expended. Then, however, with a good market, the shop will pay handsomely.

(4)—The high grade of skill required. While the process as we now know it is comparatively simple, we have to reckon with so many factors that an expert in malleable castings is a scarce article. With the range of composition for the iron for various thicknesses of the castings very close, a white iron to start with, with its double contraction, and danger of shrinkage in the interior, with the necessity of chills, the limit to the size and weight, the expansion in the anneal, etc., it is a pretty delicate task to turn out large quantities of various classes of castings, and have them all high grade. Hence the high salaries the important men must be paid, and the eternal vigilance required in the works. It must be remembered that your day's work goes into the anneal, and you do not see it for a week. The next day's work the same, and hence a mistake in the temperature of the ovens, and you have ruin for possibly a week before you find it out. I remember the slipping off of the night annealer to a nearby speak-easy, with the increase in the natural gas pressure just at that time, which meant thousands of dollars of damage for two or three hours' inattention.

(5)—The fierce competition that is met with. This is queer but nevertheless the case. In spite of all the troubles the malleable casting man has to contend with, he makes himself more by cutting his competitors' prices, until all have very little left. This is primarily the case, because to run a shop successfully and to hold an expensive organization, everybody must be busy. The first aim therefore is tonnage, to keep the shop producing at maximum capacity all the time, practically regardless of prices sometimes. Hard times drop prices in the malleable shop far quicker than in the gray iron establishment. I remember the time when castings were sold to the railroads at a shade less than two cents a pound, delivered. When it is remembered that malleable castings ought to bring a cent a pound more than the corresponding gray iron work,

it will be seen what a new man is up against in starting when prosperity is on the wane.

The further reason for this fierce competition is that nearly everybody in this line has a specialty or several of them, which sell under patents and for as high a price as the community will stand. Hence this velvet can cover a deficit to keep the rest of the works in operation. This, of course, is hard on the man who has no specialty, and hence again, the necessity of having abundant capital until such a specialty is found.

To sum up then, with a good specialty or a number of castings used in the manufacture of well paid for articles, and a sufficient daily tonnage, it is good policy to go into the malleable casting industry as a business venture; but with less than say five tons daily safe, and with insufficient working capital, and men not thoroughly trained in this line, it is better to let it alone.

A PLEA FOR THE APPRENTICE.*

WM. GEBB

The cry of the times in foundry circles is constantly and urgently for more and better trained molders. Where can you begin to more advantage than with the apprentice?

Give him instructions not only in a line of molding, but in all classes of work that come to our shop. Let him learn coremaking; show him how to manipulate the cupola, the brass furnace, in fact every branch of the trade. Then when your melter or coreboss is off, give him a chance to try his hand in these lines. You have given him responsibility in this way, even if only for a day, and you will be well repaid for it.

The time when all hands laid off because the "Czar" of the furnace did not show up is past, and there is no foundry today but that can swing in someone to fill the gap for a time at all events.

*Presented at the Philadelphia convention of the American Foundrymen's Association.

I can only reiterate that we need more high-class mechanics, and we need more all around journeymen. What more satisfaction can a foreman have than to have one of his apprentices called to manage a foundry somewhere and to have him unhesitatingly accept the responsibility and succeed. What foundry owner, though he may miss his foreman sorely at first, but that is pleased at his employe's success, if he but leaves him in friendship and probity.

So our watchword should be, education all the time and everywhere. It is only a question of time in any shop when attention to the intellectual side of men whatever the post they fill, will amply repay itself in better results, greater loyalty, and lasting benefits to the community.

DRAWING TEMPER WHEN TURNING HARD WOOD.

C. B. TURNE

The following information may be appreciated by the young and, perhaps, by a few of the more experienced patternmakers. I had made to order a very fine and handy set of turning tools that any mechanic might well be proud of, and to work with them was a pleasure, as they retained a very fine cutting edge. I was very careful when grinding, so as not to draw the temper, but one day, to my surprise, I could not get an edge on several of them and later found that a file would cut them like so much cheese. While pondering over this condition of the tools and how they got that way, one of the old journeymen in the shop said: "You have been turning hard wood, maple or cherry, and have drawn the temper by crowding them on the work." "But," said I, "I cannot see any color on the tool showing that the temper has been drawn." To prove this assertion, he placed a piece of maple wood in the lathe, took a flat file, ground and sharpened it, and proceeded to turn, and in a short time drew the temper until it was worthless as a turning tool, yet it showed no color.

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Training in Foundry Work

Notwithstanding the well intended efforts that are being made by some of our leading engineering schools, courses in foundry work, with few exceptions, fail to equip the students with the adequate knowledge of foundry practice that will permit them to be intrusted with executive authority after graduation. The instructors do not lay claim to such intentions, yet there is a dearth of material in our casting plants from which future foremen and superintendents can be drawn, and it is evident that the technical schools must ultimately plan to meet these conditions. Our leading founders have as yet been unable to agree upon a course of instruction, and as long as their opinions differ so widely no better results can be expected. The training of apprentices in foundry work, undertaken by several of the trade schools with a view to producing better molders, has been only fairly successful, although in the south the work has been undertaken along lines more practical than heretofore attempted. Working conditions, such as would be encountered in any shop, prevail and castings for commercial use are produced. In addition, the boys are paid for their services, which is an added incentive, and wonderful results have been obtained. A large foundry in the east is also training its embryo molders along scientific lines, and traditional methods have been entirely discarded. The boys, after completing the course, are not only fitted for dry, green sand and loam work, but have a knowledge of making cores, mixing sand and melting as well. The ideal course of training, not only for the engineering but the trade schools as well, will without doubt be outlined in the not distant future as a result of the many experiments which are being made, all of which have but one end in view—better equipped molders, foremen and superintendents.

English and German Foundry Production

Computations recently made place the total consumption of foundry pig iron in England during 1906 at 1,116,192 tons. This is purely an estimate, in view of the fact that no adequate statistics are available. The production of pig iron by English makers last year reached a total of 10,149,388 tons and including that taken from stock and the imports, the total consumption is estimated at 10,355,634 tons. Of this amount the steel makers used practically 6,500,000 tons, iron mills 1,075,000 tons, and the exports 1,664,442 tons. It is estimated that the foundry industry of Germany employed in 1905 2,433,910 tons of pig and produced 2,202,611 tons of foundry products. To reach this figure Great Britain would have had to employ nearly a million tons more of pig iron for foundry use, as shown above, and it is hardly probable that the scrap employed exceeded one-half of this quantity. From these figures it would seem that the German foundry industry produces a much larger tonnage of foundry products than that of Great Britain.

Trade Outlook

The iron market in all centers continues quiet and the indications are that there will be little activity until September. With few exceptions, consumers' requirements are covered throughout the remainder of the year, and spot buying is consequently limited. Production continues at a record rate, and based on the furnace output during the first half of the year, 1907 will show a total of close to 27,000,000 tons. The output for June was 2,291,030 tons, as compared with 2,237,420 tons in May. July opened with twelve more stacks in operation and the outlook is that the present rate of manufacture will not only be maintained, but increased. In the west, No. 2 foundry for immediate shipment is held at $25.50, Chicago, against $23 Philadelphia and $21 Birmingham. Bessemer is quoted at $23 in the Mahoning and Shenango valleys, equivalent to $23.90 Pittsburg. Compared with quotations prevailing one year ago, pig iron in all markets shows an advance of $5 to $8 a ton, as indicated by the following table:

Grade.	July, 1907.	July, 1906.	Advance.
No. 2 Foundry, Chicago	$25.50	$18.25	$7.25
No. 2 Foundry, Philadelphia	23.50	18.25	5.25
Lake Superior Charcoal, Chicago	27.00	19.00	8.00
No. 2 Foundry, Birmingham	21.00	14.00	7.00

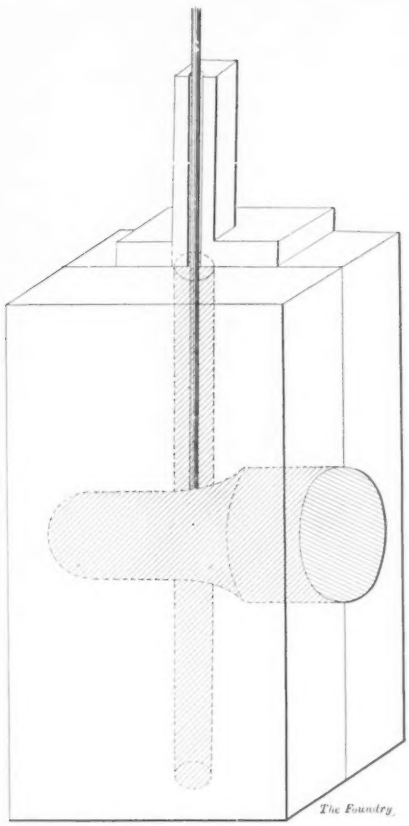
While the steel foundries are unable to cope with the requirements of the trade, gray iron jobbing foundries are suffering from a dearth of new business, although existing contracts insure a fair tonnage for several months. The large number of new shops built during the past year is a factor that must be considered in the future of the gray iron trade, and notwithstanding the rapid expansion of the country's industries, there are indications that the producing capacity of iron castings is already greater than the needs. On the other hand, the substitution of steel for iron, especially by the railroads, has resulted in a rapid growth in the demand for steel sections, and existing capacity is taxed to meet the requirements. In the malleable trade, foundries are from two or three months behind in deliveries and the outlook is exceedingly bright, owing to the activity of the implement industry. Within the last few months, however, a large number of malleable plants have been projected, several of which have already reached the construction stage, and the capacity of this line will be increased in proportion to the recent growth of the other branches of the foundry trade. Consumers of the nonferrous metals are still confronted with high prices and a scarcity of raw materials. The scrap supply has been practically exhausted and the current outcome commands prices almost on a par with the new metal. One of the leading producers of aluminum has decided to accept no orders for early shipment less than 25,000

pounds, smaller requirements being filled after the demands of the large consumers have been met. Electrolytic copper has declined slightly, although this action on the part of the leading interest, from past experience cannot be taken as an indication of weakness.

INSERTING WIRE IN A THIN CORE.

EMIL B. HORNE

Considerable difficulty is often experienced in inserting a wire straight in-

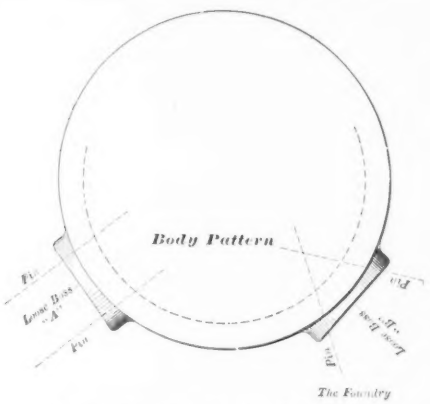


METHOD OF INSERTING WIRE IN A THIN CORE

to a rather thin core, especially if it is of such a nature that it cannot be made in halves and pasted, on account of the cost, or other reasons. I was recently compelled to make several thousand ⅜-inch body cores and our coremakers soon complained that they were unable to push down the wire straight the entire length of the core. I then made the device shown in the accompanying illustration, which immediately overcame the trouble. A plate with a grooved upright extension was placed on top of the arm core box and when inserting the wire, it was held in the groove while being driven through the core. By the use of this plate all difficulties were overcome, and it was found that the wire always traveled straight through the center of the core.

SECURING BOSSES ON PATTERNS.

The common method employed by patternmakers to secure and hold in place the loose pads, bosses, etc., on patterns or in the core boxes while making a mold or core, is to bore parallel holes for the pins as shown in the accompanying sketch



SECURING BOSSES ON PATTERNS

at boss A. I have adopted what I believe a much better method, as shown in boss B, the pins being set at an angle. Securing the loose pieces in this way serves two purposes. The pins can be inserted only when the loose piece is in its proper position, after which it cannot move sideways or out of the body of the pattern. Furthermore, I have never lost a loose piece since adopting this method, as it makes a lock on the pins and the loose piece. In connection with this we keep in the foundry various sizes of wire nails, the same as are used in the pattern shop when fastening loose bosses, etc., in the construction of the pattern, and in the event of the loss of a pin the molder has a duplicate at hand.

C. B. TURNE.

ASSOCIATIONS AND SOCIETIES

There was a large attendance at the meeting of the Birmingham branch of the British Foundrymen's Association held at the Technical school, Birmingham, Saturday, May 11, when a paper was read by F. J. Cook on "Tensile Testing of Cast Iron." Mr. Buchanan presided, and briefly introduced the lecturer.

Following the reading of the paper, which was illustrated with lantern slides, there was considerable discussion. G. Hailstone said they were highly favored in listening to such an excellent paper. With regard to the cooling of cast iron the wedge not only illustrated the effect of cooling but showed why cast iron was only good for a certain sized casting, the ideal structure being about three inches from the thin end. At about one and a half inches the silicon would be 1.5 per cent to 1.75 per cent. If it was cast in a wedge, and broken, the amount of silicon in the casting could be ascertained by measuring the size.

Mr. Foster said the paper was from a thoroughly practical man, and he was glad that Mr. Cook had advocated testing more in accordance with American ideas. He had been for five or six years of the opinion that the 3 x 2 x 1 inch test bar was a ridiculous section, with which it was impossible to get anything like a good test. He considered the tensile strength test was the most important one. He believed the American bar was 1⅛ x 1x12 inches long, and that came nearer to the ideal bar than any he knew, and, if they observed, they would get the transverse and the tensile test pretty well in direct proportion. If they got ten tons tensile on the square inch with an ideal test bar, they should get a reduction in direct proportion on the transverse. In American bars there must be about one-tenth of an inch difference but in the old practice of this country, they got different values entirely.

Mr. Parker considered that the paper had completely covered the ground, but asked whether Mr. Cook cast separately or took an average sized casting each day. His own experience was that for the control of their own mixtures and not for inspections it was best to cast separate test bars and they would get a more uniform temperature. He was in the habit of using a test bar rather longer than the one described by the author, his own measurement being 8 inches. He exhibited a specimen, embodying as Mr. Cook had shown, a gradual reduction from the gaged length to the grip of the shoulders. It had a screw grip, and its original length was 15 by one and half inches in diameter, and gave 15 to 16 tons breaking load. The remarkable thing about that was that the same day with the same mixture they cast some very thin castings, and the engineer wanted a mixture which would compete successfully and of malleable iron. The test bar gave 22 tons per square inch, tensile strength. He thought that was a remarkable test for the strength of cast iron.

Mr. Mason asked whether the casting temperature had much effect upon the bars, and also whether any difficulty was found as a result of using so much sulphur from subsequent segregations. Mr. Cook's experience seemed to be that he got the best results from the highest temperature. Mr. Longmuir in a previous paper found that he did best with a moderate temperature. He also asked whether Mr. Cook got a sound casting in dealing with motor cylinders cast on the flat with chills on the

bottom, and the thickness of the cylinder that would stand 600 pounds pressure.

Mr. Heggi considered that 1.8 per cent of phosphorus as a maximum was too high, it should not, under any circumstances, be more than 1.5 per cent although he understood from Mr. Cook that the casting was for small filigree work. He knew one case where they had excessive breakages, and on analysis they found the phosphorous just over 1.6 per cent, and the firm believed that the higher percentage was the cause. It was their practice to cast everything as hot as possible. With regard to certain remarks about temper carbon that was a controversial question, but Prof. Turner had regarded the element as temper graphite, because it was found in a solid state.

The chairman said that the particulars given of structure as affected by different rates of cooling were extremely interesting. A short time ago he was himself talking with J. B. Stead, who thought it would be very interesting to have a series of tests commencing with a long bar, say six feet long, of a certain thickness, and then reducing it a foot at a time, and so getting the different structures and strengths of the metal at these lengths. Mr. Cook's tests to some extent carried out that idea, and he seemed to have proved his contention that the present specifications for test bars do not indicate the character of the casting. In many cases the test bar was not telling the whole truth and a few years ago he had himself written an article entitled "The False Witness of the Test Bar." In many cases it was a false witness, and when it was telling the truth no man could say. There was a widespread opinion among inspectors, though he hoped their suspicions were unfounded, that foundrymen had certain knowing ways of getting a test bar to indicate a better metal than the casting itself. He could not say what amount of truth there was in the tales he had heard, but they might take it that a man who "faked" his test bars was covering up his ignorance, and proving that he did not know how to get test bars to legitimately stand the test required. If people who resorted to devious ways to get satisfactory tests would exercise as much ingenuity in doing that legitimately, they would succeed with more satisfaction to the people who employed them. They had very different results in dealing with thin and thick bars, and it was clear that light castings, relatively to their area, were stronger than heavy ones. This was due to the different structure, and possibly also to the casting, because they had to run a thin casting hotter than a thick one, and he thought that the test bar became more and more untruthful as the weight of the casting increased. About 20 years ago, he was dealing with some hydraulic cylinders, which were cast about ten inches thick, and he believed it was Lord Armstrong who reduced hydraulic cylinders to two and one-half inches metal, because he could get four cylinders with two and one-half inches metal to do everything required, much more satisfactorily than one of ten inches. They found that in a thick cylinder there was an outer and an inner area which was porous, whereas with a thin cylinder they got a satisfactory metal throughout. Regarding Mr. Cook's experiments with 100 tests he thought it was a remarkable achievement to have obtained 67 per cent breaking between 13 and 17 tons tensile.

Mr. Cook briefly replied, informing Mr. Hailstone that the silicon proportion in the specimen referred to was 1.2 per cent which was about the best percentage, for a one and one-half inch casting. He agreed with Mr. Foster that a bar 3 x 2 x 1 inches was a ridiculous test bar. In all up-to-date foundries it was discarded in favor of one by 1 x 12 inches. The tensile test was most important, although many engineers held the contrary. He thought that was because they had not gone about the matter properly. The question whether a

transverse bar would follow a tensile bar in results was very doubtful. They could get a high tensile test due to toughness and hardness, so long as the metal was not brittle. But they might have a totally different class of iron giving the same result, one due to toughness, and another due to the closer grain of iron, and hardness. A soft iron would give a high transverse test, and a hard iron would give a low one. They usually had three bars, one for hardness, another for transverse tests, and another for tensile. If they wanted to test for regulating the mixture, they must cast separately. They must have the tests under like conditions, and it was possible to do so within reasonable limits. With regard to the hundred tests which had given so much satisfaction they related to ordinary iron. But the other tests were taken over a long period and there would probably be some with harder and softer irons. The question of segregation due to sulphur was a difficult matter to deal with, because with too much sulphur they were likely to get a lot of trouble. But he still adhered to his belief that with high sulphur they would have a much better wearing cylinder where they had a high temperature to deal with, as for example with the use of superheated steam. The bad wearing cylinders he had had to deal with had always been found to be below in sulphur and high in manganese. They had been subjected to a test as to hardness, but they had worn badly nevertheless. He had not noticed any trouble in regard to segregation with a high sulphur as compared with low sulphur. He would not like to cast chills horizontally. They must cast vertically, otherwise the casting would be full of blow holes. The thickness of the first cylinder he had referred to was five-sixteenths of an inch. He did not quite agree with what Mr. Buchanan said about the testing bars bearing false witness. Of course, it would be so, unless the tests were carried out under the same conditions. It was very desirable that there should be a standard method of working the bar. With regard to the references to Mr. Longmuir he would only remark that these tests were made in a specially prepared furnace at Sheffield University, and his medium temperature was about the highest they got under ordinary working conditions in cupolas.

FOUNDRYMEN ENTERTAINED.

The regular monthly meeting of the New England Foundrymen's Association was held at the Exchange Club, Boston, on Wednesday evening, June 12. Dinner was served at six o'clock, after which the meeting was called to order by President Wm. H. Bense. It was voted that all business be dispensed with in order that the evening might be devoted to the entertainment.

The committee on arrangements provided an unusually snappy program which was altogether different from anything ever given by the Association. Prof. Howard of Boston presented his Vioscope, or moving picture entertainment, interspersed with illustrated songs. The pictures shown upon the screen were received with much favor and during the evening the members joined in the singing of all the popular songs. Enthusiasm ran high.

Announcement was made that the next meeting of the association would be held in the way of an outing, probably at Point Shirley Club, Winthrop, and it is hoped there will be a large attendance of members and their friends.

FOUNDERS VISIT THE BIRMINGHAM UNIVERSITY.

The Birmingham branch of the British Foundrymen's Association on Saturday, June 22, paid a visit to the metallurgical department of the Birmingham University. This feature proved unusually attractive, and from 50 to 60 members made a tour of the departments, under the guidance of Prof. Turner. The building has been

in process of erection for five years, and there are still developments requiring another three years to complete. About half a million has been spent, exclusive of the cost of the site. The central hall is a magnificent apartment large enough to take in the Birmingham town hall. It should be explained that the metallurgical department has been in operation for some time past, and in every way it is commodious and complete. Various rooms are arranged on either side of the main corridor, giving separate apartments for pyrometers, photographic work, research laboratory, electro-plating, etc. All the machines are operated by electric current produced from the university power house.

The metal exhibits are of a most complete character, comprising all the well known slags and ores from all parts of the world, a remarkable fact being that with some rare exceptions they have been given by friends and old students. The gold and silver ores are of great rarity and value and have come from Egypt, Johannesburg and Western Australia. There are some fine examples also of cobalt, and the specimens of pure silicon, ferro-silicon, and other elements. There was a very well equipped hall of machines and a fine pattern shop which every day is filled with students producing patterns. Generally speaking the metal departments are considered the best in the Kingdom. There is a Siemens furnace from which ingots are regularly produced, the fuel for which is furnished from a gas producer on the premises. The molding shop is small but complete. These departments are operated entirely by the students with the sole assistance of a skilled foreman and a laborer.

Generally it may be said that the rough work including the hauling and mixing of materials is done by the students themselves. There was some playful chaff by the visitors over the miniature character of the foundry, but it was recognized that completeness in foundry work is an impossibility in so diminutive a plant. On the whole, the arrangements were generally admired. Prof. Turner explained that the arrangements had been made after visits to the Massachusetts, McGill universities and the best specimens on the continent, and an effort had been made to embody the best ideas throughout the world. The general impression was that the effort had been successsful.

ASSOCIATED FOUNDRY FOREMEN OF PHILADELPHIA AND VICINITY.

The thirtieth meeting of the Associated Foundry Foremen of Philadelphia and vicinity was held in Philadelphia on June 10, when nine new members were enrolled, increasing the total membership to 112. Hereafter the papers to be read before this organization will be printed and copies will be sent to each of the members. At the close of the regular business session some of the features of the recent convention of the American Foundrymen's Association were discussed and adjournment was taken until the second Monday in September.

BIRMINGHAM FOUNDERS VISIT BLAST FURNACES.

A pleasant afternoon was spent Saturday, June 15, by the Birmingham General Branch of the British Foundrymen's Association in visiting the blast furnaces of Messrs. William Roberts, Ltd., of Tipton Green. The event proved unusually attractive, over 50 members attending, including Messrs. R. Buchanan, president of the branch, and C. Heggie, secretary. A couple of hours were spent inspecting the furnaces, under the guidance of the officials. This plant is one of the most successful in South Staffordshire, yielding a regular weekly output from the two furnaces now in operation of 1,300 tons. A third furnace is at present out of blast but is to be started as soon as it can be made ready. A special feature of the establishment, which doubtless has much to do with the large output, is the extensive ar-

rangement for calcining the ore in specially constructed kilns. This operation takes about eight weeks, and consists in simply roasting the ore with a mixture of coal and slack. The system by which waste gases are utilized for the firing of the boilers works very satisfactorily and has effected a considerable saving. The activity of the iron trade was further demonstrated by the entire absence of stock. Some time ago the firm had as much as 6,000 tons on the bank, but of this every vestige has disappeared.

CINCINNATI FOUNDRY FOREMEN.

The annual meeting of the Cincinnati Foundry Foremen was held on June 22, and officers were elected as follows: C. H. Thomas, president; John Logan, vice president; E. W. Cadwell, secretary; H. J. Holmes, treasurer; F. S. Lutz, sergeant-at-arms. Papers were read by C. H. Thomas, on "The Apprentice as Seen in One Shop," and by W. E. Mackintosh on "English Foundry Practice." After the business session luncheon was served.

FIRST ANNUAL MEETING.

The first annual meeting of the Birmingham Branch of the British Foundrymen's Association was held at the Acorn hotel, Birmingham, Saturday, April 20.

R. Buchanan, president of the organization, said that its members are carrying out a distinctive and laudable educative work and that there is no one for whom they have a greater pity than the incapable workman, who desires to do his best, but can not attain the proper degree of skill. They were all conscious of imperfections, but the deficiency is very serious when it occurs in those having charge of others. The society, he added, was organized to help the ambitious man who desired to become as proficient as possible in his calling. He stated that they also owed a duty to their country, and they should endeavor to make Great Britain a greater workshop than ever, keeping her in the forefront of the industrial work of the world, and never to be satisfied with the second place. The large attendance of members testified to their ambition, and their desire for knowledge. They sought to foster a man's pride in his business. Personally, he was never apologetic because he was a foundryman, and people who thought there was nothing in foundry work only displayed their ignorance.

F. J. Cook, secretary, reported a comfortable balance in hand.

Thanks were tendered to the officers, and the chairman was re-elected on the motion of Mr. Heggi. Mr. Heggi was elected secretary, to succeed Mr. Cook, and Messrs. Mason, E. B. Crump and F. J. Cook were elected members of the council.

The chairman proposed a vote of thanks to the press, paying a special tribute to the excellent reports that had been given by THE FOUNDRY. The local representative, Mr. Horton, was most assiduous in attending the meetings, and they thanked the press generally for the attention they had received.

J. Horton, the Birmingham representative of THE FOUNDRY, briefly acknowledged the compliment, remarking that his work had been greatly facilitated by the hearty co-operation of the officers of the association. It was stated that without doubt the great enterprise which the American press had displayed in fully reporting the meetings would be continued, in view of the increasing number of Englishmen who are becoming subscribers to THE FOUNDRY.

The Peerless Machinery & Supply Co., Wichita, Kas., is erecting a stone structure 50 x 75 feet, adjoining the main factory building, which will be used for foundry purposes.

The New Holland Machine Co., New Holland, Pa., is erecting a new foundry, 85 x 100 feet, which will enable this company to increase its output from 60 to 75 per cent.

The United Engineering & Foundry Co., Youngstown, O., is preparing plans for an addition, three stories, 85 x 200 feet, of brick and steel construction.

FOUNDRY AND PATTERN SHOP APPLIANCES AND SUPPLIES

Core Pasting Machine—Portable Pyrometer—Taylor Foundry and Pattern Shop Clamps

TO FACILITATE the pasting of cores a machine has been designed and patented by Albert Gloor, 1993 Hoyne avenue, Chicago. Fig. 1 is a view of the machine with a core for a sectional heater lying upon the plate prepared for the application of the paste to its surface. Fig. 2 shows the core with the paste applied and it will be seen that it is uniformly distributed. The operation of the machine is simple and by its use considerable time and labor is saved, as compared with the methods gererally in use.

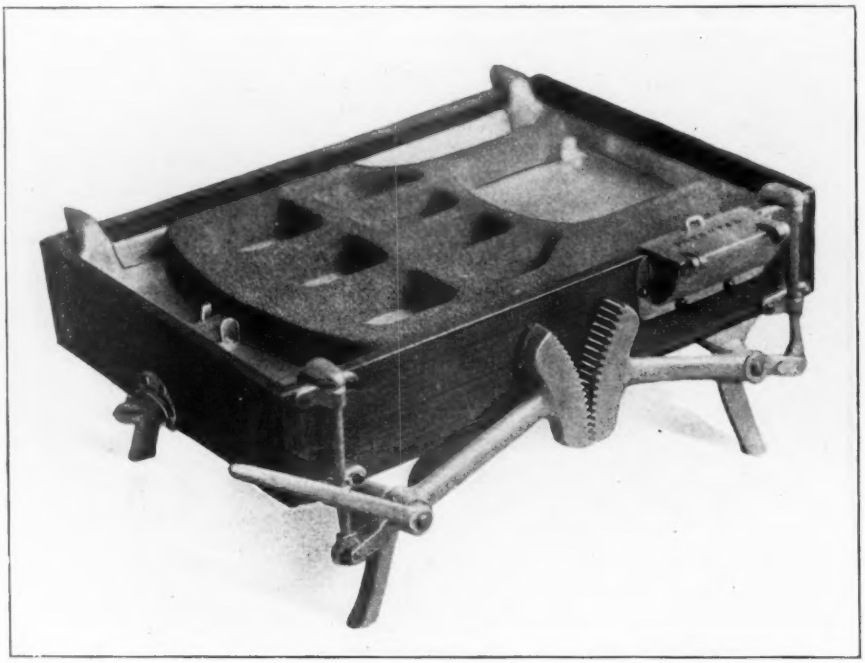


FIG. 1 —CORE PASTING MACHINE

To apply the paste to the core it is only necessary to lay the core on the plate of the machine and with a slight pressure the core and paste are forced downward into the paste bath. This brings the bottom of the core into contact with the paste in the tank below, which is forced through the slots on the plate and stenciled on the core. By releasing the downward pressure the core and plate rise to their former position. The saving of paste is also considerable, as it is only applied where necessary and in the proper quantity.

The machine consists of a wooden tank, to the bottom of which are screwed four legs. A shaft passes loosely through two of these and a rocker arm is keyed to each end of the shaft outside of the legs. These arms have forks at one end to receive a lifting rod which moves in lugs fastened to the side of the tank. The other end of the rocker arm is provided with a counter-balance whose weight can be increased or de-

creased as required. A handle is keyed to one end of one shaft which carries the rocker arm and can be used for operating the machine when pasting large cores. The perforated plate is made of cast iron with grooves cast in. It is necessary to have different plates for the various cores, all of which can be fitted to one machine.

The lifting rods enter a loose counterbore in the lugs on the plate and the same can be easily lifted off and other plates adjusted. This machine can be used to change the cores that are made in large quantities, such as are required for car coupler molds, heaters, and other intricate work. The size of the machine is not limited and it can be used with equal facility on small as well as large work.

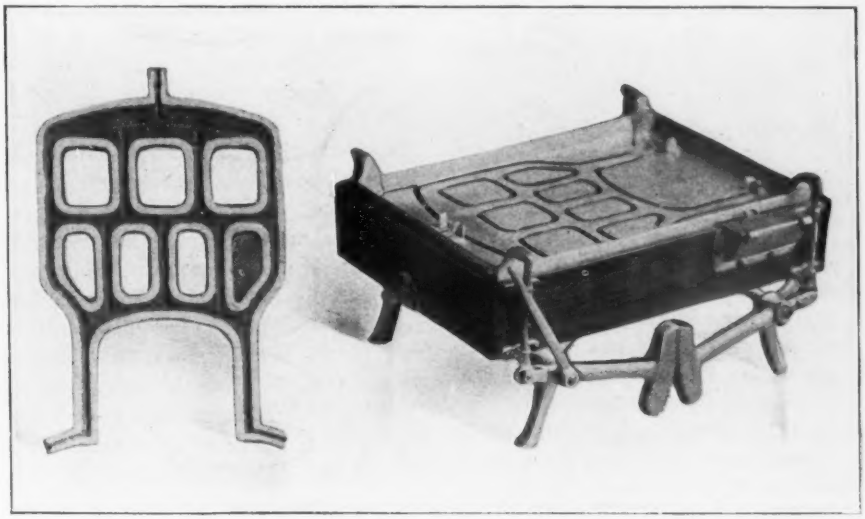


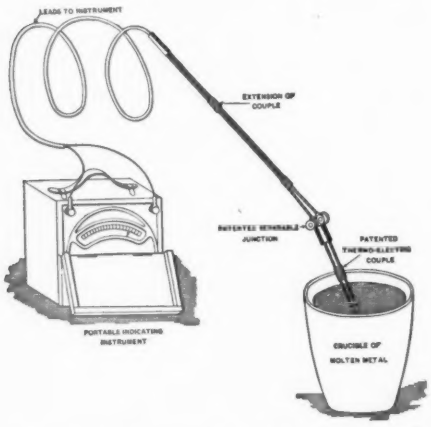
FIG. 2—CORE WITH PASTE APPLIED

A PORTABLE PYROMETER FOR TAKING TEMPERATURES OF MOLTEN METAL.

In manufacturing processes and in metallurgical work molten metals and alloys are extensively employed, especially for the making of castings from molds and it is of the utmost importance that the metals be mixed, alloyed and poured at the proper temperatures in order to obtain the best results. The special form of pyrometer illustrated herewith has been designed to meet the practical requirements of every-day shop practice. The portable indicating instrument may be carried in the hand and within two or three seconds the temperature of the molten metal may be taken.

The outfit complete consists of a portable indicating instrument connected to a special thermo-electric couple, the two elements of which are disconnected and left without insulation. When the tips of these elements are slightly immersed into the molten metal an electric connection is made and the reading on the instrument will be the same as if the couple had been originally joined. The general arrangement of the parts forming the outfit for this class of temperature measurements is shown in the accompanying diagram as it would be applied for taking the temperature of a crucible of molten metal just before pouring. The advantage of this plan is that the tips of the wires forming the elements almost instantaneously assume the temperature of the molten metal and time lag error is eliminated. This form of couple has been most successfully applied to the measurement of molten metals as cast iron, copper, aluminum, brass, bronze and other alloys.

When the tip of the couple becomes worn away by the continued use, a fresh portion is exposed to the molten metal and the reading will be the same as if the couple had not been reduced.



BRISTOL PYROMETER FOR MOLTEN METALS

A separable junction is provided, as shown in the diagram so that fresh tips can be conveniently applied before enough of the couple has worn away to appreciably affect the resistance and cause an erroneous indication on the instrument. These instruments which are being successfully used by a large number of manufacturers, are manufactured by Wm. H. Bristol, 45 Vesey street, New York City.

CLAMPS FOR THE FOUNDRY AND PATTERN SHOP.

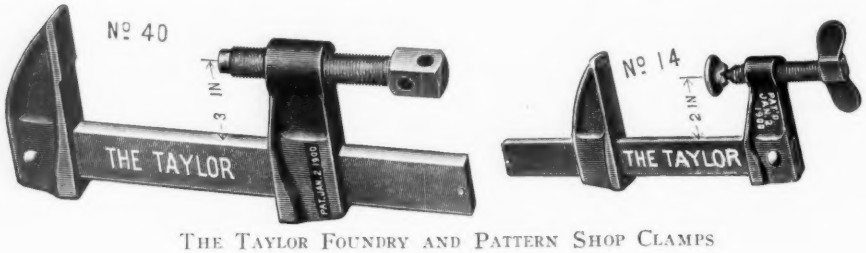
A new patternmaking clamp, shown in Fig. 1, of special design, is being manufactured by the James L. Taylor Mfg. Co., Bloomfield, N. J. The novel feature of this tool consists of the stationary head which carries the screw. For many kinds of work this clamp is very convenient, for it is often awkward to use a clamp with a small engagement, as there is not sufficient room for the hand between the screw and the bar. Fig. 2 shows a clamp designed especially for fastening foundry flasks. This tool will take a safe clamping strain of 8,000 pounds.

TRADE NOTES.

The firm of Lane & Carr, foundry and metallurgical engineers, 120 Liberty street, New York, has been dissolved, H. M. Lane retiring. He has been succeeded by Chas. H. Speer, and the firm name has been changed to Carr & Speer. Mr. Speer has had a wide experience in the foundry business, having at one time been engaged as draftsman with the Shickle-Harrison & Howard Iron Co., East St. Louis, and was later appointed master mechanic of this plant. He left this concern and was later connected with the Cambria Steel Co., Johnstown, Pa., and the Lackawanna Steel Co., Buffalo, N. Y. Throughout the construction of the Milliken Bros. Steel Works, New York, he was in charge of the drawing room, having only recently resigned. Mr. Speer is an associate member of the Amercan Society of Mechanical Engineers.

Ph. Bonvillain & E. Ronceray, manufacturers of molding machines, have established an American branch at 1315 Race street, Philadelphia, for the purpose of demonstrating the utility of their machines, which are shown in operation. All of the numerous types of molding machines made by this firm are on display.

The Iron City Coal & Coke Co., Wabash building, Pittsburg, has purchased



THE TAYLOR FOUNDRY AND PATTERN SHOP CLAMPS

the plant of the H. R. Sackett Coal & Coke Co., Uniontown, Pa., consisting of 30 ovens, 40 acres of coal land, coke crusher, etc. The plant will be known as the Dorothea works of the Iron City Coal & Coke Co.

Colne & Co., successors to Powell & Colne, 11 Broadway, New York, have closed a fourth contract with the United States government for the installation of steel casting equipment by the Tropenas steel process at the Mare Island Navy Yard, California. This concern has thus far installed 32 converters.

The Domhoff & Joyce Co., Cincinnati, has opened an office in the Railway Exchange building, Chicago, for the sale of pig iron and coke. E. T. Connors, formerly general sales agent of the Portsmouth Steel Co., Portsmouth, O., is manager.

The Northern Engineering Works, Detroit, will install three 10-ton electric traveling cranes in the new foundry which is being erected by R. Hoe & Co., New York. A Newton cupola will be used.

The Independent Pneumatic Tool Co., Chicago, manufacturer of pneumatic tools, reports that its business since the first of the year has shown a remarkable increase over the corresponding period of last year. The company's manufacturing facilities will probably be doubled before the end of the year.

The Norton Co., Worcester, Mass., has opened a store at 48 South Canal street, Chicago, where a complete line of Norton machines for cylindrical grinding, universal tool and cutter grinders, bench and floor grinders, etc., manufactured by the Norton Grinding Co., as well as aluminum grinding wheels, and other abrasive products manufactured by the Norton Co., are carried in stock. George A. Stone is manager of this branch.

The Waldie & McCauley Sand Co., 523 West 124th street, New York, recently organized, has begun the shipping of screened white beach sand from Rockaway beach to a number of large foundries in the New York district and at Connecticut points. The sand is free from shells and gravel, requiring no screening, and is loaded from the beach by a suction dredge. The company now operates three schooners between the beach and railway terminals and expects shortly to add a barge to its fleet.

The Thomas W. Pangborn Co., New York, has just completed the distribution of its souvenirs for which cards were offered at the recent convention of the American Foundrymen's Association. Owing to the hurried manner in which some of the signatures were written, it was found exceedingly difficult to satisfactorily determine some of the names and addresses. A number of the souvenirs have been reserved, however, and parties signing cards who have not received the souvenirs, can secure the same by addressing the company.

The E. H. Mumford Co., Philadelphia, manufacturer of molding machines, is sending to the trade a handsome souvenir in the form of a watch guard, to which is attached an oxidized silver charm, a replica of the Liberty bell.

Frederick A. Waldron has entered independently into the field of industrial engineering and has opened an office at 37 Wall street, New York. He is prepared to undertake the selection of factory sites, the designing of manufacturing and power plants and other work in the line of industrial engineering.

The brisk competition among exhibitors at trade conventions for a souvenir of more than passing interest has resulted in the production of some remarkably attractive articles, combining both attractiveness and utility. As an instance might be cited the souvenirs by Stanley Doggett, New York, from his Perfection Parting booth at the recent Philadelphia convention of the American Foundrymen's Association. These included a handsome automatic card index for attachment to telephone, an aluminum case with space for the insertion of the more usual calls. For the ladies of the convention there was provided an assortment of imported needle cabinets of burnt wood, automatically dropping out any size of needle desired. Although the Doggett works were doubled in capacity only recent-

ly, it has been found necessary to run overtime to meet the demand. Since the first of the year sales of soapstone facings to the foundry trade have totalled 900 tons, 400 tons being to one concern. A new building has been given over entirely to a line recently placed on the market, a prepared charcoal.

The Fox Machine Co., Grand Rapids, Mich., manufacturer of pattern shop equipment, machine tools, and woodworking machinery, recently shipped large orders to Japan, Italy and France. This concern reports that domestic trade is holding up very well and that it is operating its plant 22 hours daily.

The Independent Pneumatic Tool Co., Chicago, reports the receipt of a large order for piston air drills and pneumatic hammers from the Wisconsin Engine Co., Corliss, Wis.

TRADE PUBLICATIONS.

ELECTRIC PROPELLER FANS.—Bulletin No. 146, B. F. Sturtevant Co., Boston. Illustrates and describes electric propeller fans which are built in a full line of sizes from 18 inches to 120 inches. The motor is absolutely dust proof and the fan may be placed in any location and controlled by a switch from a distance. This type of fan, by continually substituting cool and pure air for that which is hot and vitiated, contributes alike to the comfort of those who labor and those assembled for amusement.

MOLDING MACHINES.—Herman Pneumatic Machine Co., Zelienople, Pa. Twenty-two page catalog, illustrates and describes the Herman pneumatic jarring molding machines, rotary sand sifters and pneumatic equipment for foundries. This catalog describes machines for molding skein boxes and also contains descriptions of special machines built for the manufacture of grate bars and cast iron fittings.

UNIVERSAL SYSTEM OF MACHINE MOLDING.—Ph. Bonvillain & E. Ronceray, Paris, France, and 1315 Race street, Philadelphia. Ninety-six page catalog fully illustrates the Universal system of machine molding. Part 1 is devoted to molding sand, its treatment and preparation, and describes an automatic sand mixing, rubbing and finishing mill. The second section describes the Universal system of pattern plate making and includes the reversible pattern plate process, double pattern plate process, stripping plate process and reversible Cliche process. The third section includes descriptions of standard Universal hydraulic, rotative Universal hydraulic, hydraulic assembling, special hydraulic and special assembling molding machines, automatic sand distributor, special flasks for use with molding machines, compressible screws and double acting pumps and accumulators of different sizes. The fourth section gives samples of pattern plates and various classes of castings that can be molded on these machines. The next section is devoted to auxiliary machinery and tools for use in foundries. The work is profusely illustrated and gives an excellent description of French foundry practice.

PATTERN SHOP EQUIPMENT.—Rotary File & Machine Co., Brooklyn, N. Y. Twelve-page booklet. Describes band saw filing machines, saw setters, band saw guides and brazers manufactured by this company.

CRUCIBLES.—R. B. Seidel, Inc., Philadelphia. Four-page folder giving sizes and capacities of crucibles. Also contains information regarding the melting points of metals, together with the weights of the same.

STEEL FOUNDRY EQUIPMENT.—J. W. Paxson Co., Philadelphia. Bulletin No. 17. Treats of the evolution of the side blow steel converter, and describes cold cutting off saws and Paxson-Warren sand blast machinery, steel molding sand, mold wash, etc.

LYCOPART.—Smyth, Swoboda & Co., New York. Folder describes Lycopart, which is claimed to be a satisfactory substitute for lycopodium as a parting compound for iron, bronze and aluminum work.

CONVEYORS.—C. W. Hunt & Co., New York. Pamphlet No. 073, contains 32 pages and describes towers, electric cranes, hoisting engines, and miscellaneous conveying machinery manufactured by this concern, as well as industrial railway systems.

SCREW CLAMPS.—Jas. L. Taylor Mfg. Co., Bloomfield, N. J. Twenty-four page catalog illustrates and describes the Taylor quick-acting, self-locking screw clamps and column clamps, as well as clamp supports for securing clamps on benches or horses. A list of users of these tools is also given.

FOUNDRY EQUIPMENT.—Whiting Foundry Equipment Co., Harvey, Ill. (Chicago suburb). Circular No. 76. Sixteen pages. The scope of this booklet covers in a brief form the various lines of foundry equipment manufactured by this concern. Photographs are given of installations of cranes of various types and foundry ladles, cupolas, air hoists, tumblers, trucks, turntables, elevators, etc., are also described.

CRANE.—Sprague Electric Co., New York. Leaflet describes the multiple monorail crane manufactured by this company.

CORE MACHINES.—Falls Rivet & Machine Co., Cuyahoga Falls, O. Fifty-four page catalog. This work presents a handsome typographical appearance and contains many illustrations of the core machines manufactured by this company. The machines described are as follows: No. 1, for making round cores, $\frac{3}{8}$ to 3 inches in diameter, or square or irregular cores with dies $\frac{3}{8}$ to 3 inches.

Another machine is designed for the manufacture of cores in 27 sizes, from ⅜ inch to 7 inches. Slab core machines are also described and groups of irregular shapes of cores that can be made on these machines are shown. The multiple spindle core machines, core cutting off and coning machines are also described, as well as the Wadsworth portable core oven. A list of users of these core machines is also given and includes foundries in practically every state in the Union and many in the provinces of Canada and foreign countries as well.

ELECTRIC EQUIPMENT. — Westinghouse Electric & Mfg. Co., Pittsburg. Twenty-four page catalog devoted to a description of the company's electrical equipment at the Hornell shops of the Erie railroad.

FOUNDRY FURNISHINGS. — Detroit Foundry Supply Co., Detroit. Standard size catalog, contains 431 pages. As its name implies, it is intended as a complete reference work for users of foundry supplies and practically every conceivable article used in the foundry is illustrated and described in this work. The catalog is typographicaliy handsome and the introductory notes are refreshing, inasmuch as they do not follow the beaten paths. In the way of greeting to its friends the company states that it will have six months yet to travel ere it will have reached the age of three years. Continuing, it adds: "Metaphorically speaking, we are not yet out of the woods, but we can see the clearing ahead, with the sun only at its meridian." The first section of the catalog is devoted to facings and foundry supplies, and brass equipment, general foundry equipment and fire brick follow in the order named. The catalog contains 445 illustrations and the index nearly 1,000 references.

BLOWERS.—Connersville Blower Co., Connersville, Ind., Catalog No. 10. Contains 48 pages devoted to the description of the positive pressure blowers for delivering air or gas under any pressure up to 10 pounds. Gas exhausters for artificial gas plants and high pressure gas pumps for any pressure up to 10 pounds, rotary cycloidal pumps for mining, drainage, irrigating and water works purposes, and cycloidal vacuum pumps manufactured by this company. The work is handsomely illustrated and contains valuable information to guide the buyer in the selection of machines for pumping air, gas or water.

SAND CONVEYORS.—Standard Sand & Machine Co., Cleveland. Twenty-four page pamphlet. Describes sand mixers and conveyors manufactured by this company and includes a partial list of users of these machines.

MOLDERS' TOOLS. — Burr's Damascus Tool Works, Detroit. Catalog No. 12, contains 32 pages. The fine illustrations contained in this work give an excellent idea of the quality and finish of the tools made by this company. No less than 57 different kinds of tools are described, from the square trowel to the half round corner. The catalog also contains price lists of all the tools described.

SHOVELS.—Wood Shovel & Tool Co., Piqua, O. Sixty-two page catalog. This work is without doubt an edition de Luxe and presents a typographical appearance attained by few catalogs devoted to tools of this type. Each tool is illustrated by two half-tones, one showing the profile and the other the front view. This is a new departure and will certainly be appreciated by the trade, as it is the best method by which a shovel may be pictorially described. A section of the catalog is devoted to molder's shovels and contains descriptions of the D handle, socket strap, plain back; D handle, plain strap, plain back; split D handle, socket strap, plain back, and split D handle, plain strap, plain back shovels. The index contains more than 100 references, which is indicative of the extensive line of shovels and scoops made by this company.

MOLDING MACHINES.—Killing Molding Machine Co., Davenport, Ia. Catalog No. 6. Describes the roll-over, stripping roll-over suitable for difficult drags, automatic stripping rock-over, stripping plate, and other types of molding machines made by this company. Other accessories are also included, such as the Killing self-releasing flask, everlasting snap flasks, etc. Instructions are also given regarding the ordering of machines and the mounting of patterns on machines made by this concern.

CLAMPS.—Batavia Clamp Co., Batavia, N. Y. Sixteen-page pamphlet devoted to a description of Colt's quick adjusting, self-locking clamps manufactured by this concern. Malleable and steel bar wagon jacks are also described.

CORE COMPOUNDS.—C. E. Mills Oil Co., Syracuse, N. Y. Sixteen-page pamphlet. Describes and gives directions for using the dry core compound manufactured by this concern, as well as Syracuse core oils. Illustrations are given of large cored sections made by the use of these compounds and core oils. Testimonial letters are likewise included from leading foundries throughout the country.

GRINDING WHEELS AND MACHINERY.—The Norton Co., Worcester, Mass., catalog, 146 pages. This publication supersedes all others issued by this company. The principal abrasive now used in the manufacture of Norton grinding wheels is alundum, manufactured by a special electrical process in the company's own plant at Niagara Falls, N. Y. In addition to its use in grinding wheels, this material is being used on cloth and paper for abrasive purposes and in the grain for grinding and polishing. This work, in addition to the detailed descriptions of grinding wheels and other grinding equipment, contains valuable data on tests for safety methods of mounting, rules for calculating speeds and tempers of tools, and a table of grinding wheel speeds.

The product of the company consists not only of grinding wheels, but grinding machinery, alundum, India oil stones, bricks and sticks for rubbing and sharpening, scythe stones, knife sharpeners, bath machine indicators, etc.

STACKS.—M. W. Kellogg Co., New York. Forty-eight page catalog, entitled "Some Stacks." It sets forth the advantages of the improved perforated, corrugated radial brick for chimney building used by this company. The work is profusely illustrated and contains views of chimneys erected for large power plants, ranging from 100 to 250 feet in height. Two of the latter size were built for the Public Service Corporation of New Jersey, at Newark, and are styled as the "Heavenly Twins." Their internal top diameter is 9 feet 6 inches.

PNEUMATIC HAMMERS.—Ingersoll-Rand Co., New York. Bulletin No. 2010. Twenty-four pages, 6 x 9 inches. The hammers are fully described and every detail of construction is shown. They are made in five sizes for chipping, calking, scaling, flue beading, etc., and in four sizes for driving rivets from the smallest up to 1⅜ inches in diameter. The bulletin also gives an interesting exhibit of a displacement air meter by which the performances of these tools have been tested and verified.

CYLINDRICAL GRINDING MACHINES.—Norton Grinding Co., Worcester, Mass. Catalog No. 7, 63 pages. Illustrates and describes the line of plain cylindrical grinding machines, for straight and taper work, manufactured by this company. The machines equipped for overhead drive range in size from 6 x 32 inches to 18 x 168 inches; electric drive, 10 x 50 inches to 14 x 72 inches; and self-contained electric drive, 18 x 96 inches to 18 x 168 inches.

CRANES.—Northern Engineering Works, Detroit. Booklet No. 22, issued merely as a brief reminder of the equipment manufactured by this concern, which is intended to supplement the larger catalogs of cranes and hoists which describe more fully these appliances.

PNEUMATIC TOOLS.—Dayton Pneumatic Tool Co., Dayton, O. Forty-eight pages. Describes the pneumatic riveting, chipping and calking hammers, sand rammers, pneumatic drills, tube expanders, bolt clippers, cylinder hoists, heating forges, electrical tools and air compressors manufactured by this concern. The catalog is well illustrated with sectional views of many of the appliances.

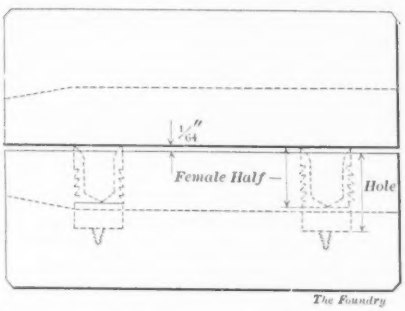
THERMIT STEEL FOR WELDING.—Goldschmidt Thermit Co., New York. Twenty-four page booklet. Describes the use of thermit steel in the repair of shrinkage holes and surface flaws in castings and forgings, as well as the welding of stern frames for steamers, dredge buckets, cylinders, motor frames, etc.

SKYLIGHTS.—Arthur E. Rendle, New York. Four-page circular, devoted to a description of Paradigm skylights and fireproof windows or sidelights. Describes numerous notable installations and contains many testimonials from some of the largest concerns in the country.

PLANT ECONOMY.—The Bristol Co., Waterbury, Conn. Eight-page bulletin written by H. P. Dennis, M. E., a well-known authority on power plant equipment.

INSERTING BRASS DOWEL PINS.

Inserting brass dowel pins in core boxes or patterns so that they will match accurately is a simple and yet troublesome operation if not done correctly. I know of a number of ways, but the best one, I believe, is shown in the sketch presented herewith. Some patternmakers insert dowels before doing any cutting or turning. I prefer, however, when



METHOD OF INSERTING BRASS DOWELL PINS

possible, to put them in when the job is nearing completion, as I am then able to locate them to the best advantage. In the accompanying illustration is shown two views of a plain round core box, with the female halves only of the dowels inserted. After locating them, holes should be bored the correct size for the female half, which is then driven in, allowing 1-64 to protude as shown. Then place the other half of the box or pattern on top, give it a light tap with the hammer, over the protruding brasses, which will make a circle in the upper half. In the center of these circles bore a hole slightly smaller than the circles, after which the remainder is cut out with a small gouge. You are then prepared to drive the male pin. The female should then be driven flush with the face. Never strike the top of the female pin, as it destroys its fine edge, but put both together and strike on the end of the male pin.

PATTERNMAKER.

GENERAL INDUSTRIAL NOTES

The Lidgerwood Mfg. Co., 96 Liberty street, New York, which recently occupied a large new iron and brass foundry in Newark, N. J., finds that its pattern shop and storage building is inadequate and is making a large extension.

The James F. Powers Fdy. Co., Elkton, Md., states that it is building an addition to its plant 40 x 96 feet long and 20 feet to the square. An air plant will be installed.

The Browning Foundry Co., Ravenna, O., has been incorporated with a capital of $150,000 by W. S. Krake, W. H. Marsh, E. R. Taylor, G. H. Robinson and R. L. Hawkins.

The S. Jarvis Adams Foundry Co., Fourteenth and Etna streets, Pittsburg, has nearly completed its new plant at Midland, Pa., and will remove its old plant and begin operations in the new one early in August. The cupola will have a daily capacity of 200,000 to 250,000 pounds. In addition to its present line of brake shoes, pipe balls, axle boxes, etc., other specialties, which have not yet been decided upon, will be manufactured.

The new plant of the United States Cast Iron Pipe & Foundry Co., Scottdale, Pa., is now in operation. It is said to be the largest single plant in the world devoted to the manufacture of cast iron pipe. It is built principally of reinforced concrete and the main structure is 650 x 123 feet. One of the pipe cleaning sheds is 350 feet in length. The most modern equipment has been installed and the plant is operated throughout by electricity.

The new plant of the Rome Machine Foundry, Rome, Ga., has been placed in operation. Logging and mining cars and mining machinery will be manufactured. The directors are: C. R. Porter, J. H. O'Neill, R. N. Towers, W. M. Towers Jr. and Robert W. Graves.

The M. T. Davidson Co., Brooklyn, N. Y., has been incorporated with a capital stock of $400,000, and will continue the foundry business formerly carried on by M. T. Davidson. The directors are: M. T. Davidson, W. C. Newell, John Low, W. A. Drewett and Oran Baldwin.

The I. N. Conrad Iron Co. is moving its plant from Hillsdale, Mich., to Boyne City, Mich., where it will occupy two brick buildings, 30 x 60 feet and 30 x 75 feet, respectively.

The McConnell Engineering & Machinery Co., Tacoma, Wash., has been incorporated with a capital stock of $100,000, to engage in general foundry and construction work. The incorporators are: Niven McConnell, Charles A. Foster, Chester Thorne, Herbert S. Griggs and Louis W. Pratt.

August Heckscher has been elected president of the Central Foundry Co., 116 Nassau street, New York, having heretofore been a member of the directorate. William H. Remick has been added to the board.

The Southern Pipe & Foundry Co., Knoxville, Tenn., has been incorporated with a capital stock of $50,000 by F. S. Mead, J. G. Simpson, John C. Houk, H. M. Houk and others. A plant will be erected for the manufacture of sewer pipe of various sizes.

The Cedarburg Foundry Co., Cedarburg, Wis., recently incorporated with a capital of $5,000, will make a general line of castings and do machinery repair work. The incorporators are: J. Lauterbach, T. Lauterbach, M. Richard and A. Goldberg.

The Harold Foundry & Machine Co., New Kensington, Pa., has been incorporated with a capital of $50,000 by Herman H. Harold, William E. Kenney and Emery L. Sponseller, all of New Kensington.

The Portsmouth Machine & Casting Co., Portsmouth, O., has purchased and is now remodeling the plant of the Portsmouth Foundry & Machine Co. This concern has surplus molding capacity and is seeking castings under 10 tons in weight per section.

New Construction.

The American Brake Shoe & Foundry Co. is now erecting its new plant at Chattanooga, Tenn. The buildings, of brick, steel and frame, include a main foundry building, 100 x 350 feet, and machine shop, 40 x 60 feet, with smaller buildings for core room, office building, sand sheds and storage bins.

The Chicago Malleable Castings Co., West Pullman, Chicago, will at once erect a new brick building, 75 x 250 feet, for the manufacture of cores. The plans insure excellent light and ventilation, as well as the economical handling of materials. From convenient side tracks sand, resin, etc., will be unloaded directly into storage bins, passed through the mixing machinery and then to the core makers. The cores, after baking, will be placed on cooling racks, and from these, inspected, counted and handed to the molders. This building will be in the center of a group of molding departments, making it easily accessible.

The Fort Pitt Malleable Iron Co., Pittsburg, is making extensive additions to its plant at McKees Rocks, Pa. These include a 100-foot extension to the main foundry building and a 180-foot extension at one side of the same building, and there are under consideration plans for a further extension of 100 feet. The company is putting in a new 150-horsepower Babcock & Wilcox boiler and a 150-horsepower Corliss engine to furnish power for the new additions and handle its increased output.

The Shelby Foundry Co., Shelby, O., has just completed additions to its plant and equipment which have increased its capacity over 100 per cent, and can now turn out 25 tons of finished castings daily. The company makes a specialty of custom work, particularly machined gray iron castings, and is prepared to handle work up to 10 tons.

The Bay View Foundry Co., Sandusky, O., has outgrown its present quarters and has asked the city council for a site on which to erect a new plant.

The Vincennes Pipe & Casting Co., Vincennes, Ind., incorporated with a capital of $50,000, is building a new plant at South Vincennes for the manufacture of soil pipe and fittings, Murphy boilers and general castings. The buildings will include a foundry, 50 x 200 feet; cleaning room, 60 x 30 feet; machine shop, 30 x 60 feet. It will have an initial daily capacity of 10 tons of iron. Charles L. Rundle is resident and general manager; John D. Lacroix, vice president; Cornelius F. Posson, secretary and treasurer; Gustave Schiffko, superintendent.

The Cast Thread Fittings & Foundry Co., Seneca Falls, N. Y., is increasing the capacity of its foundry by tearing down the frame structures at one end of its plant and erecting a brick extension in their place, in which a new cupola will be installed.

The Amherst Foundry Co., Amherst, N. S., is repairing the building of its plant which was recently damaged by fire. Some sand blast machines, enamel mills, blowers, drills, emery grinders, etc., were damaged by the fire, but no heavy machinery, as that class of equipment was in the other buildings.

The Nevada Engineering Works, Reno, Nev., is erecting a new foundry, 50 x 100 feet and 25 feet high, with steel truss roof, which will be equipped with a 10-ton Whiting electric crane, coremaking machines, tumbling barrels and other up-to-date machinery. Electric power will be used throughout and an auxiliary steam plant will be installed to be used in case of emergency. R. F. Roy is president. The company manufactures mining and special machinery, iron and brass castings, etc.

The Advance Foundry Co., Dayton, O., recently incorporated with a capital of $25,000, is rebuilding its foundry plant which was destroyed by fire some time ago, and will equip it with new machinery. The incorporators are Thomas M. Sweetman, George A. Engel, Annie Engel, William C. Kette, and Mary E. Sweetman.

The Brockville Malleable Iron Co., Ltd., Brockville, Ont., has incorporated, with a capital stock of $60,000, and will erect a plant with a daily capacity of 10 tons of malleable castings. John A. MacKenzie is president and John Connolly secretary and treasurer.

The Manufacturers' Foundry Co., Milwaukee, recently organized by eastern capitalists and several Milwaukee business men to engage in the general foundry business, is erecting a new foundry plant on a tract of 20 acres near the southern limits of the city. It is expected that the plant, which will cost $250,000, will be ready for occupation by early fall, and will employ a force of 200 experienced workmen. Fred Devere, formerly of the Devere & Schloegel Lumber Co., is president and will personally direct the building and management of the foundry.

The Pittsburg Valve & Fittings Co., Barberton, O., is completing an addition to its foundry, 64 x 160 feet, which will be equipped with two large air furnaces, each of which will have a melting capacity of 35 tons of malleable iron.

The Shull Steel Casting & Mfg. Co., Canton, O., is building a 10-ton open-hearth furnace, annealing furnace and core ovens.

The Decatur Foundry Co., Decatur, Ind., recently incorporated with a capital of $30,000, is constructing a new plant, which will consist of four buildings. The main foundry building will be 60 x 220 feet, and the building for core, pattern and finishing rooms will be 36 x 140 feet. The product of the plant will be gray iron castings of light and middle weight and also castings of brass and aluminum.

Brass Works.

The Standard Brass Foundry Co., Cleveland, is erecting a building 64 x 98 feet to be used as a molding floor. It is planned to convert the present brass foundry into a cleaning department and machine shop. Core ovens will be installed, as well as general machine shop equipment, including lathes, etc.

The Wm. Howell Brass Works Co., Camden, N. J., has been incorporated with a capital of $50,000. The incorporators are: John S. Turner, C. Harry Latham and Frank R. Howell.

The Atlantic Brass & Iron Foundry, Boston, has been incorporated with a capital stock of $35,000. Philip Broomfield, Chelsea, is president and treasurer, and Morris Broomfield, Chelsea, clerk.

The Gray Iron Foundry Co., Reading, Pa., has practically completed the additions to its foundry. A brass foundry will be added, for which an addition, 30 x 56 feet, has been made. The electro-galvanizing department will be largely increased and a new department of electro-plating, which will cater especially to the jobbing trade, will be added.

Fires.

The plant of the American Steel Foundries, Indian Harbor, Ind., was burned July 4, entailing a loss of $50,000.

The plant of the American Radiator Co., St. Louis, was partially burned June 24.

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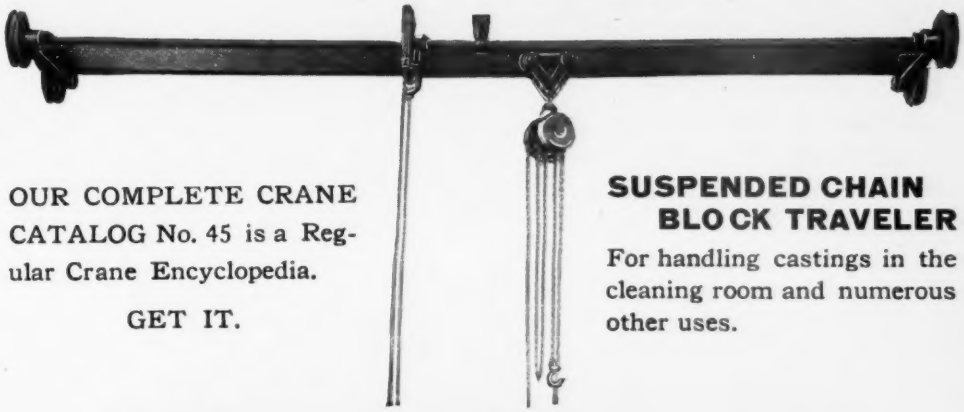

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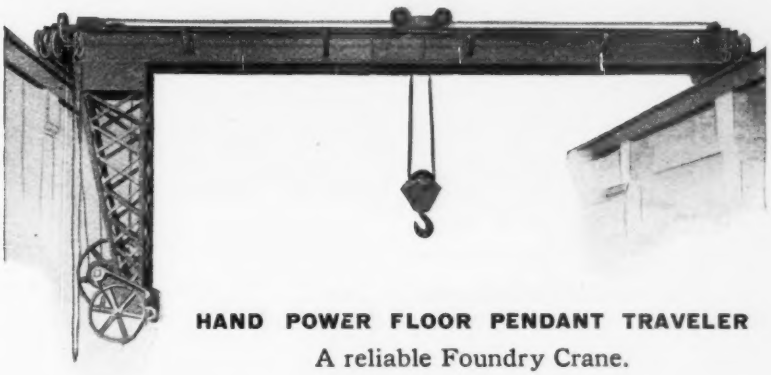

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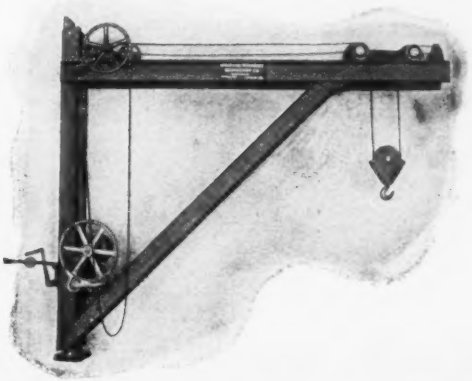

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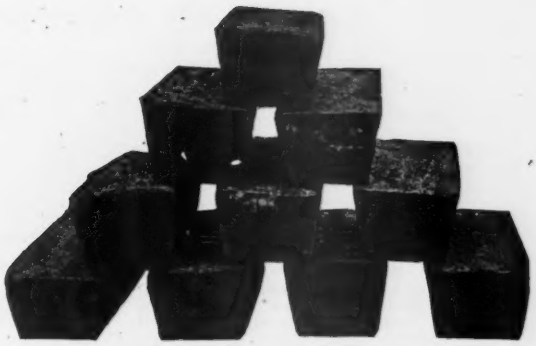

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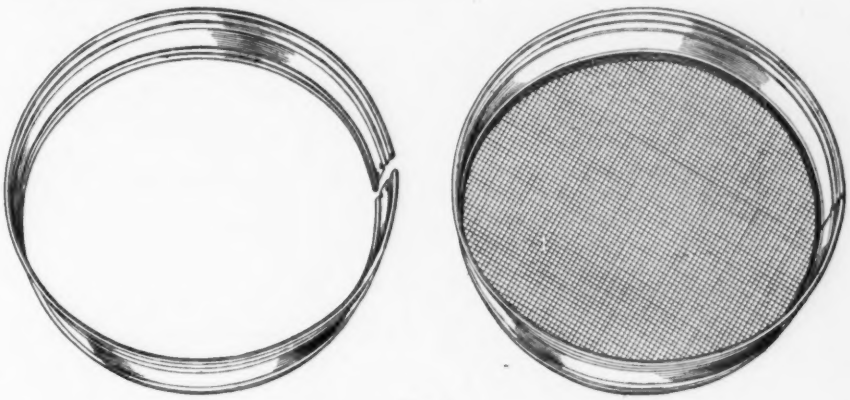

Fig. 36

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If you wear a hole in the mesh the the efficiency is gone.	Put in a new bottom.
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Price, complete, 3 dozen lots, - -	$6.00 per doz.
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Hill & Griffith Co., Cincinnati.
MacKeller's, R. Sons Co., Peekskill, N. Y.
McCormick, J. S. Co., Pittsburg.

Continued on page 164.

The Cost of It

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Such a system is accurate, quick and in ample detail, and it gives the detailed costs of every part of the work while the business is fresh—when it is most valuable as a basis of comparison.

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Maurer, Henry, & Son, New York.
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Obermayer, S. Co., Cincinnati.
Pangborn, Thos. W. Co., New York.
Sly, W. W., Mfg. Co., Cleveland.
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Smith, J. D., Foundry Supply Co., Cleveland.
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Taylor, Robert J., Inc., Philadelphia.
Whitehead Bros. Co., Providence, R. I.

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Hammers:

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Continued on page 166.

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"I find comfort in the feeling that this thing is figured to a nicety for me each month. Our average cost of castings last month was .0242½, which resulted in an increase in the price per pound to a customer, which contract we made some time ago with one of the railroads with whom we do considerable business; our monthly account showing that we were losing money by continuing along the same price. This is where the benefits of your labor come in."

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Wonham & Magor, New York.

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Northern Engrng. Works, Detroit.
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Killing Molding Machine Co., Davenport, Ia.
Manning, Maxwell & Moore, New York.
Maywood Foundry & Machine Co., New York.
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Mumford, E. H. Co., Philadelphia.
New England Eng. & Equipment Co., Boston.
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Rathbone, John A., Detroit.
Smith, J. D., Foundry Supply Co., Cleveland.
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Pattern Letters:

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McCullough-Dalzell Crucible Co., Pittsburg.
Obermayer, S. Co., Cincinnati.
Pettinos Bros., Bethlehem, Pa.
Ross-Tacony Crucible Co., Philadelphia.
Smith, J. D., Foundry Supply Co., Cleveland.
Stevens, F. B. Detroit.
United States Graphite Co., Saginaw.

Continued on page 168.

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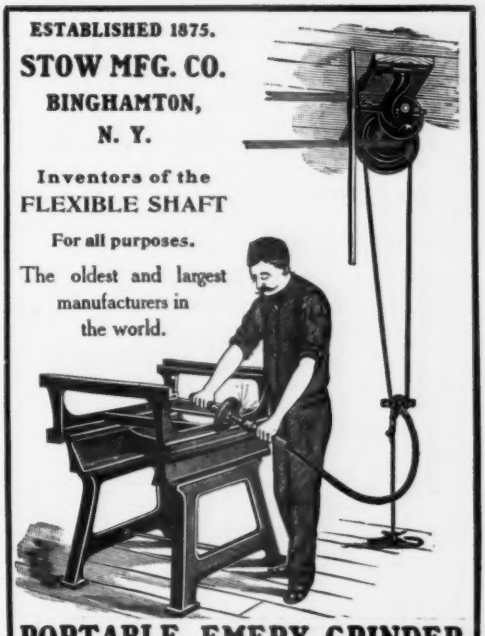

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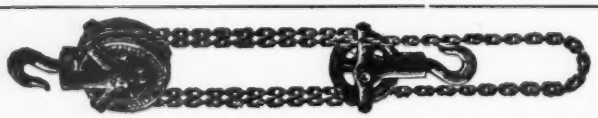

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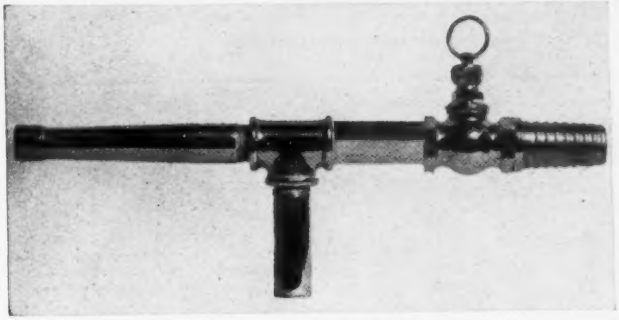

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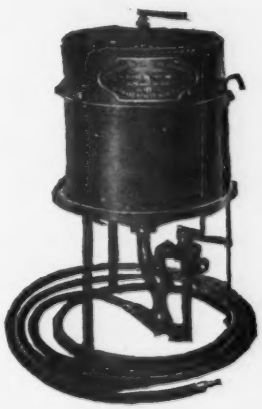

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SUPERINTENDENT OF ARCHITECtural foundry desires a change. Have had 10 years' experience with one large firm. Heavy columns and light ornamental castings. A-1 references. Address Box 551, THE FOUNDRY, Cleveland, O.

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POSITION WANTED AS FOUNDRY foreman. Light and heavy work. Twenty years' experience. Good references. Address Box 562, THE FOUNDRY, Cleveland, O.

POSITION AS FOREMAN WANTED BY a first-class foundryman with good executive ability on light and heavy work. Can furnish best of references. Address Box 926, THE FOUNDRY, Cleveland, O.

FOUNDRY FOREMAN WISHES POSITION; 22 years' experience, 7 years foreman, jobbing green, dry or loam. Practical experience at cupola, also foundry equipment. Would like to correspond with firm commencing gray iron foundry. Best references. Address Box 563, THE FOUNDRY, Cleveland, Ohio.

POSITION AS FOUNDRY FOREMAN wanted. Machinery or jobbing shop preferred. Up-to-date in all foundry practice. Middle West or eastern states prefererd. References furnished. Address Box 960, THE FOUNDRY, Cleveland, O.

POSITION WANTED AS FOUNDRY foreman by a young married man experienced in green and dry sand molding machines and cupola practice. Have good executive ability and can furnish references. Address Box 566, THE FOUNDRY, Cleveland, O.

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BUSINESS OPPORTUNITY. A GRAY iron foundry with an established business and capacity of 750,000 pounds per month, fully equipped for heavy work, would take in an active partner desiring to buy an interest in the business. For details address Box 534, THE FOUNDRY, Cleveland, Ohio.

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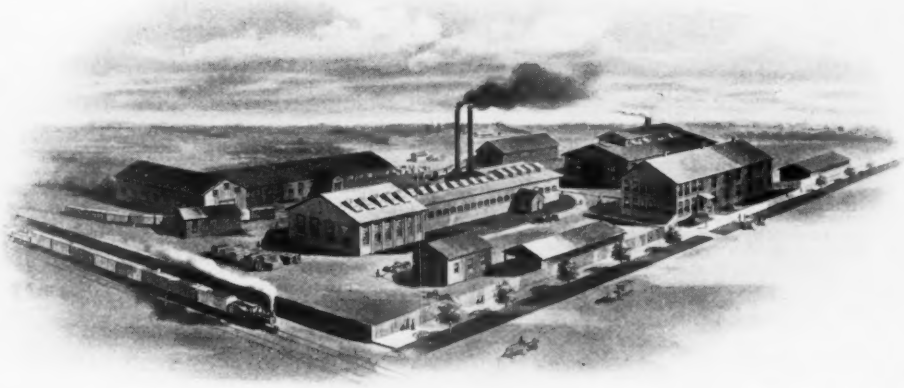

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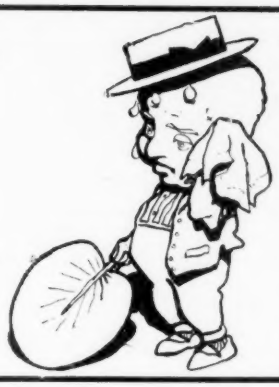

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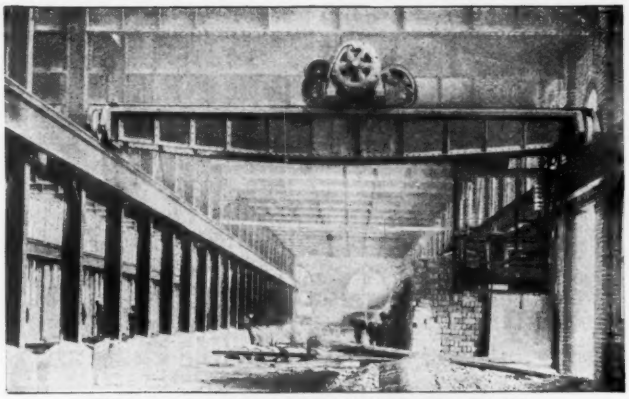

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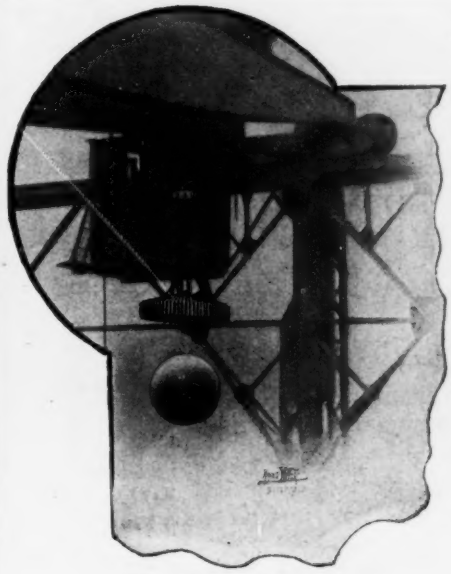

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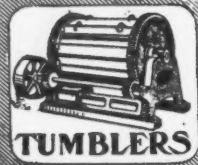

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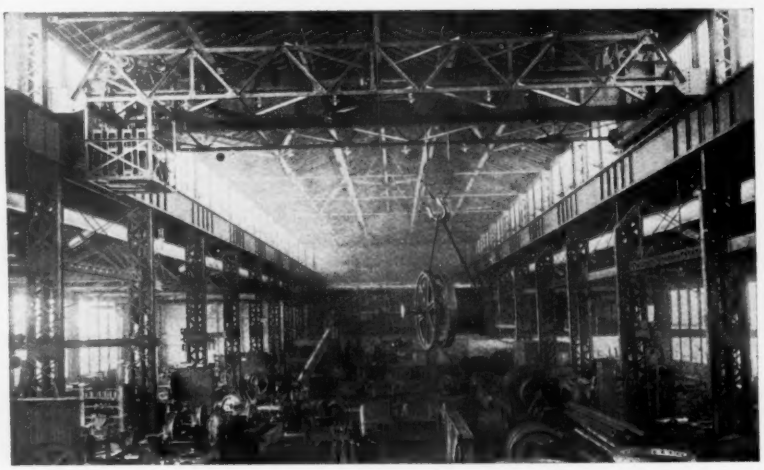

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